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CONTENTS

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Chem. & Met.

NEXT MONTH

Although Power Transmission is by no means exclusively a chemical engineering subject, nevertheless it is one with which chemical engineers must often familiarize themselves. Furthermore, the special requirements of chemical and other process industries usually impose severe burdens on power transmission equipment, in some cases even requiring the development of non-standard designs.

It is for these reasons therefore that *Chem. & Met.* plans next month to present as the fourth of its series of technical Reports a discussion of Power Transmission, particularly as it applies to the chemical engineer's requirements in process industries.

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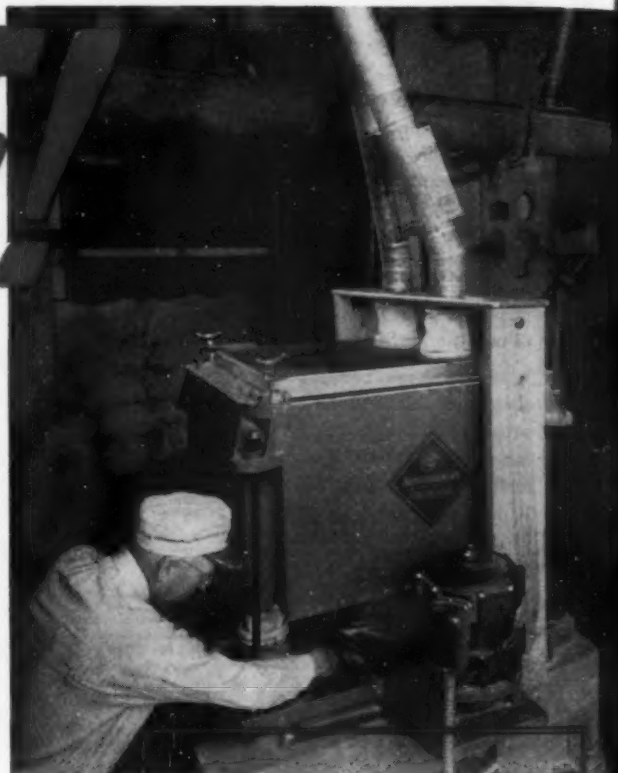
THE PROCESSOR'S *LAST LINE OF DEFENSE!*



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ESTABLISHED 1902

JUNE, 1940

S. D. KIRKPATRICK, *Editor*

RESEARCH—OUR GREATEST RESOURCE

GERMANY during the past few years has been busy substituting "research for resources." As a war-torn world knows only too well, she has ruthlessly used all the techniques and knowledge that modern science and industry had to offer. That, on top of a terrific drive for production efficiency and intense concentration on the one job of military preparedness, probably accounts as much as anything else for the annihilating progress of the German war machine.

We have no desire in this country to create any such Frankenstein or to regiment all of our energies and resources into preparation for a war of aggression. But in organizing our own national defense program we would be worse than blind if we did not see a lesson in the comparative performances of Germany and the Allies. What was it that most seriously handicapped England and France during the years that Germany was building her war machine? It was primarily a breakdown in the technology of invention and production. We suspect, too, that politics and so-called social reforms were permitted to distract them from their main objective. England had her left-wing labor troubles, France her sit-down strikes, 30-hour weeks and nationalization of industries. No wonder technical progress was slow and faltering. No wonder the Allies went into battle with little better than first World War equipment. Politics is an impossibly heavy burden on the back of industry, especially in wartime.

We have been told that in Germany the government called into council all of the leaders of the various industries. They were given sufficient of the plans to know what was expected of them and then they were asked—or forced—to supply the best scientific knowledge and production experience they could bring to bear on the problem at hand. They were especially encouraged or instructed to put their best research men and engineers on the job of developing new materials, new techniques and new machines. Their work was remarkably coordinated and organized into a great master plan. And apparently nothing was allowed to stand in the way of the efficient execution of that plan.

Only in case of dire necessity would American industry accept such regimentation by government dictation. But we believe there can and should be more effective coordination and fuller use of our vast industrial resources. The greatest of these is research, which if properly encouraged and supported can be of inestimable value in our preparedness program. No nation, not even Germany, has the technical manpower, the research laboratories or the engineering facilities that we have here. And a man like Compton, Kettering or Weidlein should be able to organize them in the public interest, promptly and efficiently and without any question of political dominance or influence.

The pattern for much of the work ahead of us has already been worked out. We have demonstrated that, if necessary, we need not be dependent on any foreign source for nitrogen, potash and iodine. More recently rubber has been added to this list as duPont, Goodrich, Standard Oil, Dow and others reveal the results of their latest researches. New sources of toluol for TNT and glycerine for dynamite are awaiting full-scale development. Lacquer and resin finishes, paper and plastic containers can conserve or replace our tin supply. So on down the list of strategic and critical materials that one after another have yielded to American research.

President Collyer of Goodrich, in his announcement of the first commercial automobile tire to be made from all-American raw materials, expressed his confidence that "the American public can be relied upon to demonstrate this truth—*that free men, cooperating voluntarily, can solve our nation's problems.*" There is the answer to any threat of foreign supremacy in science, technology or industry. Let's get behind a program to substitute "research for politics."

FROM AN

AN IMPORTANT DISTINCTION IN CHEMICAL PREPAREDNESS

Making America ready for any military emergency involves much of chemical preparedness. As in the case of mechanical equipment, there are two distinct types of requirements. Some goods and some machines are needed that have no peace-time counterpart. Other goods and other machines are regular peace-time commodities and devices put to military application, often with little or no modification from their ordinary forms.

There is no sharp line of distinction between the two groups, but it is usually not difficult to classify specific commodities. For example, T.N.T. has relatively little peace-time application, but tremendous military importance. Sulphuric acid has large war-time usage, but it is not primarily a military commodity. In the field of mechanical devices, one would find in the military class things like anti-aircraft and anti-tank guns, machine guns, and other weapons and specialized devices like tanks. But there are many other things like armored cars, tractors, and special motorized equipment that are merely modified forms of peace-time automotive equipment.

The distinction between the two classes of goods in which chemical engineers are interested is more than academic. It should have a very practical significance in determining the method by which this country will make its necessary preparation. Let's see how the two classes of goods can be prepared for military use by two very different systems. For this purpose let us take T.N.T. and the two raw materials from which it is made, ammonia and toluol. Here is the way the government might logically reason:

Industry can expand capacity for the manufacture of toluol and of ammonia very considerably at not too great a cost for new capital. If assured of a substantial market now and potentially very great market later, it is logical that the manufacturers of these goods should get ready to supply them in adequate volume even for military emergency periods. There may be need for some indirect subsidy or some assurance of markets for a certain period. But the government does not need to put up the money, build the plants or man them. Chemical enterprise can do this better, cheaper, quicker. Uncle Sam needs his energy elsewhere. He should, therefore, leave these jobs to the chemical corporations.

There is no comparable need for commercial establishments to make T.N.T. The government should therefore put up the money by which suitable plants can be designed and built with the expectation of permanent government ownership. Industry should be asked only to insure that there are skilled, trained, experienced men who are capable of operating these plants and who may be taken over by the government in case of emergency. It is rather unimportant whether the operation be by such experienced industrial men hired by the government or whether some corporation by contract becomes the operator using such personnel. The point is that the financial obligation for the investment is governmental. And only the responsibility for the availability of trained management and senior operating personnel should rest on industry.

Presumably in this T.N.T. plant would be included capacity for converting ammonia into nitric acid. It would be much better to have that conversion capacity at the point of use of the acid and under government ownership. It would have little peace-time significance but great military importance. And, of course, also it would be necessary for the government to provide suitable transportation facilities, probably tank cars, for moving the ammonia and the toluol from point of production to the T.N.T. plant for use. The existence of these specialized tank cars of capacity beyond peace time need should be insured at government expense. Then if they are idle in peace time, they are of no greater economic significance than idle artillery, bombers, or tanks which all will hope can stay indefinitely garaged at some arsenal.

If chemical executives will go over the problems associated with commodities in which their companies are interested, they will probably be able to classify most of them in one or the other of the groups described by the foregoing examples. They will probably be able to figure out how they can do their reasonable share without excessive

EDITORIAL VIEWPOINT

financial risk on the part of their companies. And they will be able to work out a definite production program to be submitted to military authorities at the proper time to show their readiness.

All this discussion is probably an oversimplification of a very difficult set of problems. But it does illustrate an important basic principle too often overlooked in the World War and almost altogether ignored lately. If each company will prepare to do its part, then all interested companies in collaboration with the military authorities will be able to work out an understanding as to location, capacities, methods, financing and other important factors by simple, straightforward exchange of views. On the basis of such mutual understanding, it ought not to be difficult to give the new Council of National Defense assurance with respect to those commodities for which chemical executives are responsible.

CHEMICALLY SELF-SUFFICIENT

Chemical industry has a large responsibility in the effort to make America more nearly independent of supplies from the rest of the world. Regardless of willingness to trade, there is only restricted opportunity for foreign commerce. Chemical industry must, therefore, be prepared to supply from domestic sources all of the materials commonly brought from abroad.

As it accepts this responsibility, the chemical industry can rightly ask its customers to accept some share of the risk and the burden. One recent response of chemical users shows an attitude which is not proper on the part of chemical purchasers. The case occurred in the match business. A small firm was clamoring for potassium chlorate. It was urging every chemical maker to produce this for its urgent needs. It agreed to sign a contract for needed supplies; but it was frank enough to say that it would buy from the cheapest source "regardless of contract." Obviously negotiations broke down at that point.

There are not many chemical raw materials urgently needed in this country which must come from abroad. Specialties, yes; but standard staple commodities, very few. This is fortunate. But for those commodities which American users wish to have American firms produce in this emergency period they should pay properly and agree to stay with their new supplier for some time to come.

It is not profiteering for the producer of such chemicals to ask that a substantial share of the new capital so risked be retired promptly. Those lacking raw materials of a chemical sort must expect temporarily to pay a bit more. That is only their share of the burden of establishing a permanent economic supply within the United States. Ultimately the cost will be no greater than from foreign sources using cheap labor.

It is to be hoped that chemical buyers will accept properly their part of the responsibility in making America reasonably self-sufficient with respect to all important chemicals.

A BETTER PRICE INDEX

Producers and users of chemicals have for many years noted with some disappointment that the government's chemical price index has often varied out of harmony with apparent conditions in the market. It is a real satisfaction, therefore, to have during April and May an entirely new chemical price guide from the Bureau of Labor Statistics. It is evident that the new index, which has been established by the wholesale price division, is much more closely in accord with actual market conditions.

It is a matter of satisfaction to note that the Bureau staff has had the experienced assistance of the staff of the Manufacturing Chemists' Association. The new commodity list on which the chemical price index is to be based is far more significant than any previous government effort. And it is fortunate that the related groups of commodities, drugs, fertilizer materials, mixed fertilizers and so forth are wisely selected, and that these groups are segregated from the true chemical list.

We of *Chem. & Met.* have another reason for satisfaction in this new chemical price index. We find that the recalculations made by the government extending back to 1926 follow very closely our own price index as we have been issuing it for nearly twenty years. The Bureau averages seldom depart more than one single point from the *Chem. & Met.* index of the past several years. We join with the industry in welcoming the new index as an authoritative and official reference base of proper significance.

. . . . .Through

In helping to dedicate Purdue University's fine new building for its School of Chemical and Metallurgical Engineering, the editor of *Chem. & Met.* draws an interesting parallel in developments within teaching and publishing, citing opportunities for greater service.

These are changing, challenging, critical times. Everything we do or say, hope or plan for, is predicated on the preservation of our ideals for a free people. It is quite fitting, therefore, that we should think of this occasion in terms of service to our fellow men, to our scientific and engineering professions, and through them, to our community, state and country. Viewed in such light, this meeting takes on a deeper purpose. It becomes part of Engineering's broad program for "directing the forces and materials of nature to the benefit of mankind."

Above the door of this great building stands, in bas-relief, a most interesting design. We see a blast furnace and a filter press, an autoclave and an acid tank car, the crossed alembics of the ancient alchemist and the challenging torch of knowledge and progress. Surrounding these symbols of chemical and metallurgical engineering are four simple, significant words—"Service Through Chemical Change."

What better creed is there to express the fundamental purpose of our work and that of our profession? We serve a great cause, and a sound one, in advancing the application of chemical and physical sciences to the problems of American industry. As a profession we are comparatively young, but in the last few decades we have grown rapidly in strength and influence. With that growth has come great opportunities as well as responsibilities.

May I illustrate the progress of chemical and metallurgical engineering during this period by briefly citing some rather intimate history? Shortly after the turn of the present century a small group of chemists and electrical engineers foresaw a great potential development of electrochemical industry at Niagara Falls. In April, 1902, they founded the American Electrochemical Society and shortly thereafter were instrumental in establishing a new technical journal called *Electrochemical Industry.* Within two years that magazine had outgrown the narrow scope of its title because many important electrometallurgical developments were already claiming its attention. So the name was changed to *Electrochemical and Metallurgical Industry* and for eight years it survived even such a tongue-twisting title. By 1910, however, it had become increasingly evident that the industrial applications of chemistry and metallurgy were dependent on engineering. So again the name was changed, this time to *Metallurgical and Chemical Engineering.* For seven years and in keeping with the dominant trend in American industrial development, metallurgical engineering was in its ascendancy. Then came the World War in which the chemical engineer received his baptism of fire, to emerge and build, with the help of the metallurgical engineer, a new profession and service to industry. Hence no one objected seriously in 1918 when *Met. & Chem.* became *Chem. & Met.*

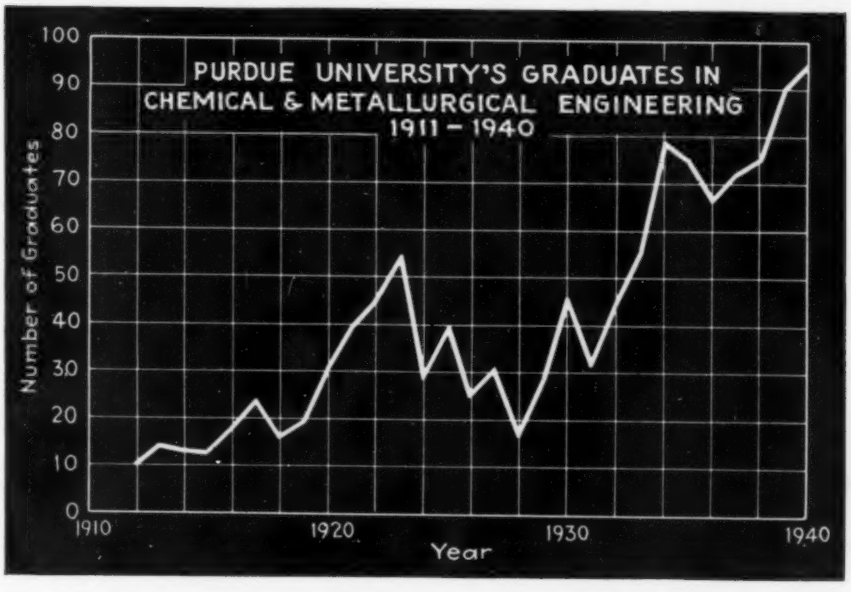
All this finds a striking parallel in Purdue's School of Chemical and Metallurgical Engineering. At the turn of the century a young electrochemist was contributing his share to the development of the first and greatest electrometallurgical industry at Niagara Falls. He served as superintendent and director of the laboratories for the Pittsburgh Reduction Co., which was then pioneering the production of aluminum by the Hall process. When in 1903 its name was changed to that of the Aluminum Co. of America, Harry Creighton Peffer became superintendent and director of research for its alumina plant in Illinois. He ably discharged these duties in industry but all the while he was primarily interested in teaching and in 1911 he welcomed the invitation to help Purdue in establishing its School of Chemical Engineering.

Professor Peffer was given space in the basement of the old Chemistry Building, but he liked it down there and in 12 years his graduating classes had increased five-fold. Many of his men are today the recognized leaders in American industries.

By 1923 the old basement quarters of the "cellar rats" were outgrown and new space was found in Purdue Hall. At the same time, Professor J. L. Bray, who had spent 12 years in metallurgical work in this country and in several South American countries, was invited to establish a metallurgical option in Purdue's School of Chemical Engineering. Metallurgy's success paved the way for a new course of instruction in gas engineering in 1928. Professor F. L. Serviss came in 1929 to expand the

Chemical Change

This new four-story building for the School of Chemical and Metallurgical Engineering at Purdue was dedicated June 15 during the Fifteenth Mid-West Intersectional Meeting of the American Chemical Society. Costing more than $600,000 it is unusually well equipped for engineering studies



work in geology and Professor R. N. Shreve arrived in 1930. The latter's course in organic technology opened an important and rapidly developing field of chemical engineering and greatly stimulated graduate study, which had been started in 1921. Today there are 43 graduate students in chemical engineering with 17 working toward their doctorates.

With 50 seniors and a proportionate number of under-classmen in 1934, the school had once more outgrown its quarters before new ones could be provided. So it followed Mechanical Engineering into Heavilon Hall, while plans for this new home were being carefully formulated and prayerfully suggested to the authorities. Unfortunately, Professor Peffer did not live to see them consummated. A year after his death in 1934, he was succeeded by Professor Bray whose success in developing metallurgical instruction led President Elliott and the Board of Trustees in 1938 to approve a new curriculum and the granting of a new degree in Metallurgical Engineering. Then came the change in name to the School of Chemical and Metallurgical Engineering and the recognition represented by this fine structure so admirably equipped for undergraduate instruction and graduate research.

These splendid facilities are worthy of the fine tradition of Purdue's School of Chemical and Metallurgical Engineering. They add purpose and meaning to that creed of "Service Through Chemical Change." More and more in the future the industries of Indiana and of the nation are going to look to this school for help and guidance. Chemical changes underlie so many industrial processes that most of the manufacturing industries of the world are to some degree dependent upon chemical and metallurgical engineering. Public health and protection from disease are chemical responsibilities. New materials, new techniques and new industries are the products of chemical change. And great as are all these peace-time contributions, there is no stronger arm of the national defense than will be found in the industries and individuals who embrace the professions of chemical and metallurgical engineering.

So, as we face the uncertainties of the future, let us be proud of our heritage and worthy to shoulder the important responsibilities that will be demanded of us. Whether our work is in the laboratory or the plant, in engineering or business management, we can be thankful that we have been trained for service through chemical change. It is the greatest opportunity of all—a challenge to create the things that will make the world a better, safer and healthier place in which to live.

For all these reasons Purdue University is fortunate in that it has built so soundly and provided so well for what the late John Hays Hammond has called the "engineering of the future."

Chemical engineering, more than any other, may be called the engineering of the future. . . . The chemical engineer stands today on the threshold of a vast virgin realm; in it lie the secrets of life and prosperity for mankind in the future of the world.

Sidney D. Kirkpatrick

Alkali-Chlorine Developments

R. L. MURRAY, *Hooker Electrochemical Co., Niagara Falls, N. Y.*

Chem. & Met. INTERPRETATION

There has been a rapid increase in the number of operating chlorine plants in the United States, and the industry is still growing. The ammonia-soda industry met this increased competition from electrolytic producers by going into the chlorine business themselves. During this period of expansion numerous improvements have been made in production. Methods for cooling, drying, purification and liquefaction of chlorine have been improved. The trend in caustic evaporation has been toward higher purity of product and steam economy through higher rates of heat transfer. Another recent development is the deposited diaphragm cell. Indications are that more chlorine will shortly be produced by it than by any other one make of diaphragm cell in this country. —*Editors.*

THE ELECTROLYTIC ALKALI INDUSTRY in the United States today comprises 42 sizable plants in 17 states plus several small installations for hypochlorite manufacture. At least 56 establishments have existed at one time or other during the course of this development. In general, those plants which began primarily as producers of alkali and chlorine have survived and developed into important factors in the chemical industry.

Fig. 1 shows the comparatively rapid increase in the number of operating chlorine plants in the United States; it shows that particularly large increases occurred about 1916-1917 and that the industry is still expanding. Many different types of cells have been employed in these installations.

It has been impossible to obtain complete and accurate statistics on the production of chlorine in the United States, but Fig. 4 has been compiled from many different sources and is at least fairly indicative of the growth in chlorine production capacity in the United States. It seems reasonably certain that during part of 1937 and toward the end of 1939 this production capacity was nearly all utilized.

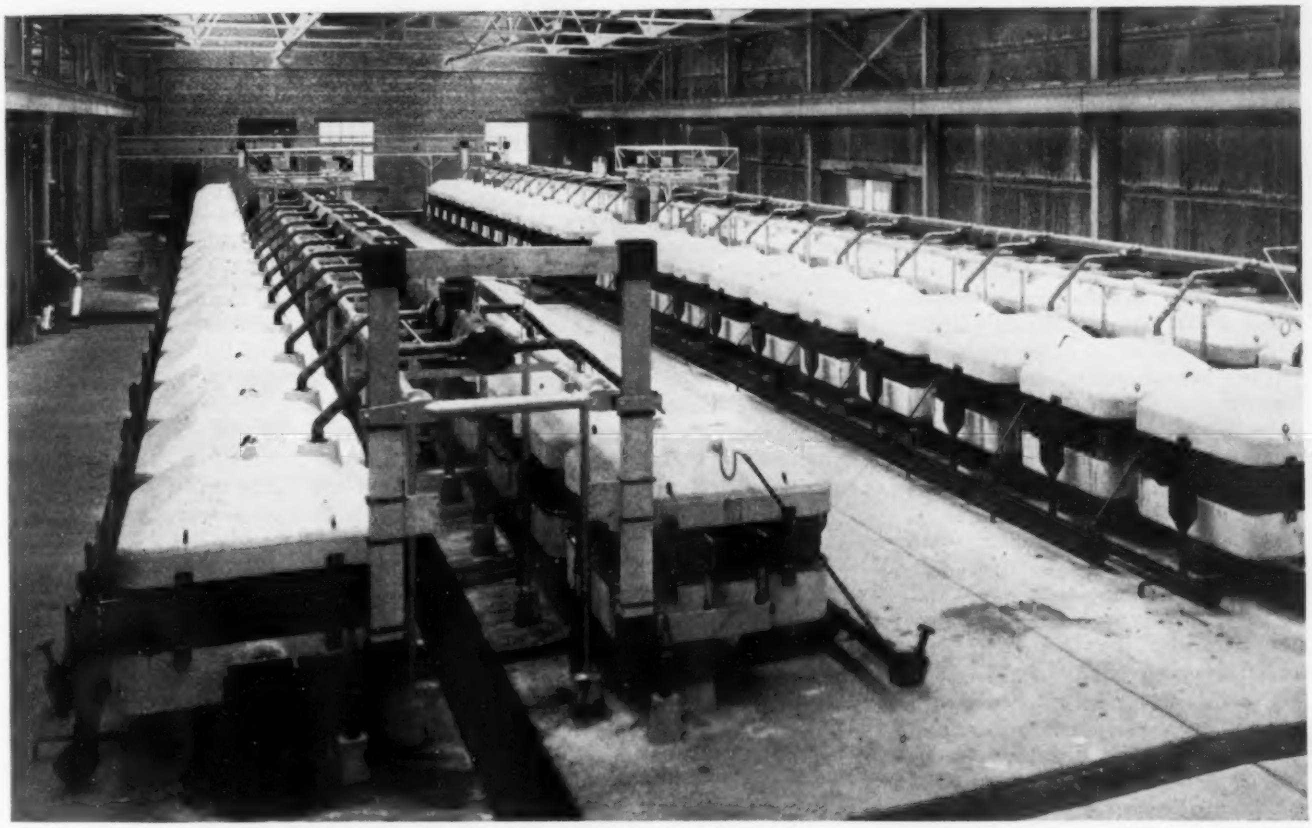
Fig. 3 shows the location of all of the important chlorine producing plants in the United States. Small installations for the production of sodium hypochlorite, of which there are several, have not been included. The symbols on the map differentiate the plants according to general type of cell used, namely, mercury, fused salt, soda ash, or diaphragm, and indicate whether the plant is operated in conjunction with either a soda ash plant or a pulp mill. The large circles show the principal chlorine producing centers in the United States, the areas of these circles being roughly indicative of the tonnage of chlorine produced in the particular locality.

An interesting story could be told about the increasing production of electrolytic caustic soda in comparison with the production of ammonia-soda caustic soda. Fig. 2, compiled from figures given in U. S. Census reports and *Chemical and Metallurgical Engineering,* shows the relationship between the production of ammonia-soda caustic soda on the one hand and electrolytic caustic soda on the other. The ammonia-soda industry met this increased competition from the electrolytic producers by going into the chlorine business themselves. Since 1926, six plants for the production of electrolytic caustic soda and chlorine have been built in conjunction with soda ash plants. The first was that of Solvay Process Co. at Syracuse, followed by Diamond Alkali Co. at Painesville, Ohio; Solvay at Baton Rouge, La.; Columbia Chemical division of Pittsburgh Plate Glass at Barberton, Ohio; Southern Alkali Corp. at its new soda ash plant at Corpus Christi, Texas; and Michigan Alkali Works at Wyandotte, Mich. Mathieson Alkali has its electrolytic plant located separately from its soda ash plants. Two important factors in the growth of chlorine production in these plants have been the availability of brine from existing supplies and the development of high pressure steam generation and bleeder turbines, which makes cheap power available as a byproduct of steam generation for process uses.

It is not to be expected that the resulting competition for the available chlorine market between the soda ash chlorine producers and the non-soda ash chlorine producers was carried on without a rather drastic reduction in the price of chlorine. Fig. 5 shows the listed market prices of chlorine since 1921. This drastic lowering in the price of chlorine has greatly stimulated its use and has been an important factor in the growth of its consumption.

Although not electrolytic chlorine, it would be an oversight to fail to mention Solvay's development of chlorine production as a byproduct of its huge nitrogen fixation plant at Hopewell, Va. Reduced to its fundamentals, this process involves the production of chlorine and sodium nitrate from salt and nitrogen fixed from the air. Very serious technical and chemical engineering difficulties

Based on a paper presented before the Niagara Falls meeting of the American Institute of Chemical Engineers, May 13-15, 1940.



Type "S" cells in the Tacoma, Wash., plant of Hooker Electrochemical Co.

have had to be overcome in its development. A study of the fundamental economics of this process as a competitor of electrolytic processes for the manufacture of chlorine would be very interesting, but is beyond the scope of this article.

The availability of salt is all important in the production of electrolytic alkali and chlorine. Rock salt, brine wells and salt domes and salt from solar evaporation of sea water represent the important sources and the development over the past forty or fifty years of brine wells and long pipe lines for brine transporation has been noteworthy. Distance seems no barrier and at least one pipe line for conveying brine for alkali and chlorine production exceeds 50 miles in length. The mining of rock salt has also undergone improvements until such salt is now available to near-by electrolytic producers at a cost only slightly higher than the cost of brine from wells when the capital cost for the development of such wells and the cost of pipe line to transport the brine are taken into account. Solar salt particularly from San Francisco Bay, has been of vital importance in the development of the electrolytic alkali industry on the Pacific Coast. The transportation of this solar salt in large boat loads is worthy of mention.

Along with the delivery of salt, either as brine or as solid salt to the electrolytic plant, real improvements have been developed in the purification of brine for electrolytic purposes. This is important because this purity has a marked influence on the efficiency and cost of the electrolysis which follows. No diaphragm cell has yet been developed which electrolyzes efficiently more than about half of the salt fed to the cell. During the concentration and purification of the caustic liquor, the residual salt is recovered and returned to the process. The recycling of the salt results in an accumulation in impurities, especially of sulphates in the brine. A number of improved methods have been developed to remove these impurities from the process.

Advances have been made in the art of generating power and converting alternating to direct current during the past 30 years. Mercury arc rectifiers of various types are now being used in several plants in preference to motor generator sets or rotary converters. Few, if any, motor generators or rotary converters have been discarded, unless worn out, to be replaced by rectifiers, but plants which have been built recently have installed rectifiers. The capacity and number of cells involved are important factors in this situation, since rectifiers are less efficient at low total circuit voltages and can only be used economically when they can operate at higher voltages. The development of high pressure steam generating plants and bleeder turbine power has already been mentioned and has been a real influence in the growth of the electrolytic alkali industry.

Methods for cooling, drying, purification and liquefaction of chlorine have been improved. The cooling of hot, wet, chlorine gas down to 12 to 14 deg. C. which just avoids the formation of solid chlorine hydrate which would cause plugging of pipe lines, is done in several ways. Some of these are: stoneware chlorine lines submerged under water in trenches; stoneware disk coolers; water cooled glass pipes; and rubber lined steel pipes. The cooling is done either with or without refrigeration, depending on available water temperature and the cost of sulphuric acid. Drying is done with sulphuric acid in stoneware or leadlined, steel drying towers and also in stoneware tourills which have a higher investment cost but are somewhat more economical to operate.

Corresponding advances have been made in the compression of chlorine, the compressors being almost invariably the means of creating the suc-

tion which withdraws the chlorine from the cells. Broadly speaking, there are two main methods—one employing the use of centrifugal sulphuric acid sealed compressors such as Nash hydro turbines which compress the chlorine to a rather modest pressure (15-30 lb.) and the other involving various types of reciprocating compressors, most of them sulphuric acid lubricated or sealed, which go up to a considerably higher pressure, such as 75 lb. or more.

The necessary refrigeration to liquefy the compressed chlorine is done in single stage and multiple stage; ammonia, carbon dioxide and Freon are the refrigerants generally employed. The economic balance between compression of chlorine with single or multi stage refrigeration, and the refrigerant to be used, involves questions such as power consumption and the cost of power, liquefaction efficiency required, and the usual balance between continued employment of already existing equipment versus its replacement by new equipment of an improved type. Mention is here made of the Pennsylvania Salt Company's interesting method of chlorine purification by passage of the chlorine to be liquefied counter-current to liquid chlorine in a bubble cap column.

The trend in caustic evaporation has been toward higher purity of product and steam economy through higher rates of heat transfer. The development of the use of nickel tubes, nickel or nickel armored steam chests and nickel or nickel clad vacuum pans and pumps has been noteworthy and is now fairly standard practice. The use of forced circulation as applied to electrolytic caustic beginning about 1927 afforded higher rates of heat transfer through the tubes and made possible the use of smaller tubes and, therefore, less investment in nickel. Many combinations of evaporators are used in electrolytic caustic evaporation but the reverse flow triple effect with forced circulation is now generally considered the most efficient arrangement.

For many years electrolytic caustic soda was inferior in quality to ammonia-soda caustic soda. However, developments over the past 15 years have resulted in the production of high purity, low-salt electrolytic caustic soda so that a substantial tonnage of electrolytic caustic soda in liquid form is now being used with satisfaction by viscose rayon manufacturers. There is now electrolytic diaphragm cell caustic soda available in large tonnage which is quite equal in quality to the caustic soda produced by the ammonia-soda process. Among others, the work of A. H. Hooker was outstanding in the development of methods of high grade electrolytic caustic soda production.

The economical recovery and utilization of the hydrogen obtained as a coproduct from the electrolysis of salt solutions has seen substantial development and many of the electrolytic plants are now utilizing the larger proportion of the hydrogen which they produce. Synthetic ammonia, the production of synthetic hydrochloric acid by burning with chlorine, the hydrogenation of oils, and the production of various chemicals by high pressure hydrogenation are some of the ways in which electrolytic hydrogen is employed.

Any review of the chlorine industry would be incomplete without mention of the outsanding developments in liquid chlorine containers and in methods of transportation. Single unit tank cars were employed as early as 1909 by the Pennsylvania Salt Co. Since then, chlorine tank cars have been improved in design and increased in capacity. The development of the "ton container" by Mauran and Rowland and the shipment of these containers on the so-called multi-unit underframe car has been

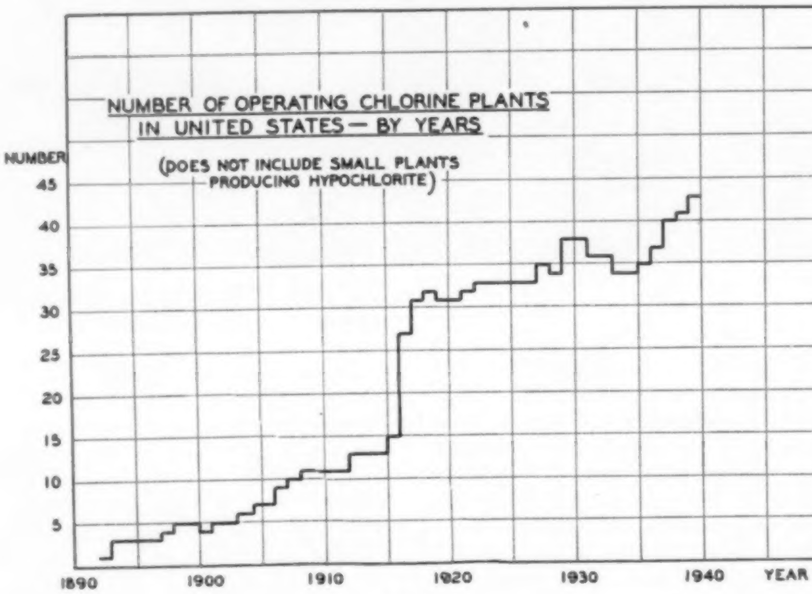


Fig. 1

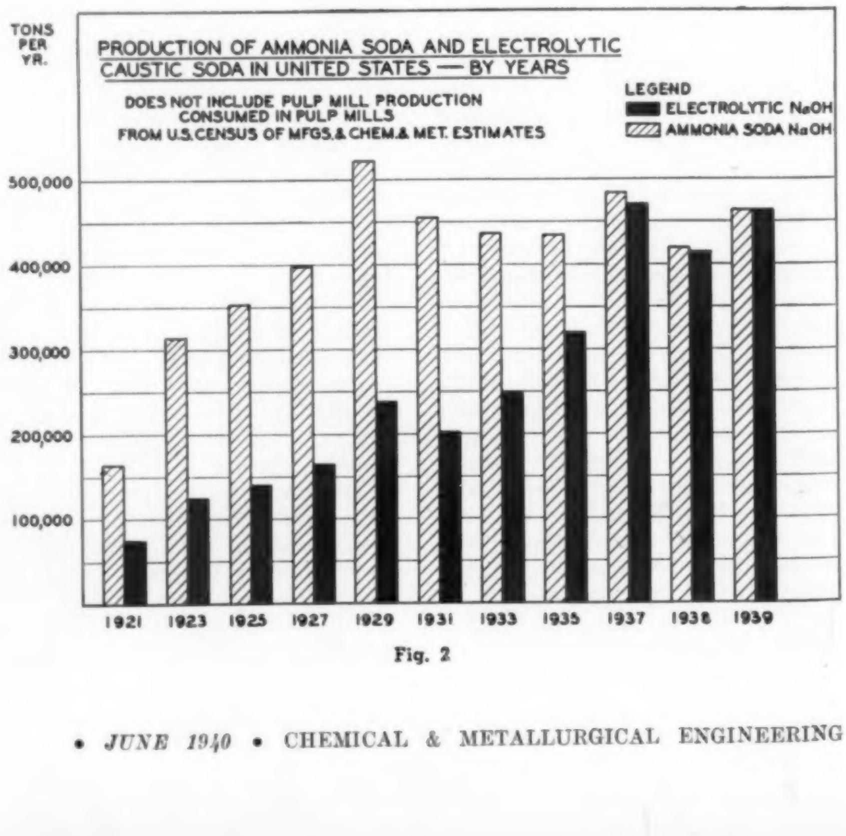


Fig. 2

an interesting and important contribution to the industry. According to Chlorine Institute records, there are now about 950 single unit cars and 270 multi unit underframes in use in the United States for the transportation of liquid chlorine. The Test & Specification Committee of the Institute, together with the engineering staffs of the various producers, both Institute members and non-members, have played an important part in this development and in the wonderful safety record which has been built up on the shipment of chlorine over the last quarter of a century.

The last few years have seen a great increase in the production and

(Please turn to page 409)

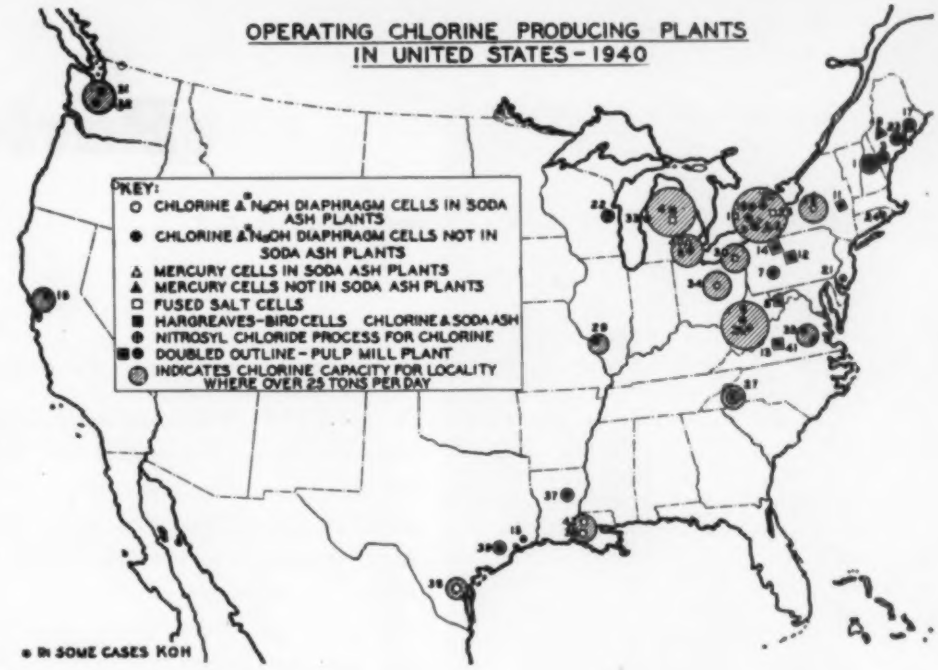


Fig. 3

1—Brown Co., Berlin, N. H.
2—Mathieson Alkali Works, Niagara Falls, N. Y.
3—S. D. Warren Co., Cumberland, Me.
4—Dow Chemical Co., Midland, Mich.
*5—Niagara Alkali Co., Niagara Falls, N. Y.
6—Pennsylvania Salt Mfg. Co., Wyandotte, Mich.
7—D. M. Bare Paper Co., Roaring Spring, Pa.
8—West Virginia Pulp & Paper Co., Piedmont, W. Va.
*9—Westvaco Chlorine Products Corp., South Charleston, W. Va.
10—Hooker Electrochemical Co., Niagara Falls, N. Y.
11—West Virginia Pulp & Paper Co., Mechanicville, N. Y.
12—West Virginia Pulp & Paper Co., Tyrone, Pa.
13—West Virginia Pulp & Paper Co., Covington, Va.
14—Castanea Paper Co., Johnsonburg, Pa.
15—Gulf Oil Corp., Port Arthur, Tex.
*16—Great Western Division, Dow Chemical Co., Pittsburg, Calif.
17—Penobscot Chemical Fiber Co., Great Works, Me.
18—Oxford Paper Co., Rumford, Me.
19—Niagara Smelting Corp., Niagara Falls, N. Y.
*20—Isco Chemical Co., Niagara Falls, N. Y.
21—E. I. du Pont de Nemours & Co., Deepwater Point, N. J.
22—Kimberley-Clark Corp., Kimberly, Wisc.
23—Eastern Manufacturing Co., South Brewer, Me.
24—Fields Point Mfg. Corp., Providence, R. I.
25—E. I. du Pont de Nemours & Co. (R. & H.), Niagara Falls, N. Y.
26—Belle Alkali Co., Belle, W. Va.
27—Champion Paper & Fibre Co., Canton, N. C.
*28—Solvay Process Co., Syracuse, N. Y.
29—Monsanto Chemical Co., East St. Louis, Mo.
30—Diamond Alkali Co., Painesville, Ohio.
31—Hooker Electrochemical Co., Tacoma, Wash.
32—Pennsylvania Salt Mfg. Co., Tacoma, Wash.
33—Morton Salt Co., Manistee, Mich.
34—Pittsburgh Plate Glass Co. (Columbia Division), Barberton, Ohio.
35—Solvay Process Co., Hopewell, Va.
36—Solvay Process Co., Baton Rouge, La.
37—Southern Advance Bag Corp., Hodge, La.
38—Southern Alkali Corp., Corpus Christi, Tex.
39—Champion Paper & Fibre Co., Houston, Tex.
40—Michigan Alkali Works, Wyandotte, Mich.
41—Hercules Powder Co., Hopewell, Va.
42—Ethyl Gasoline Corp., Baton Rouge, La.

* KOH as well as NaOH.

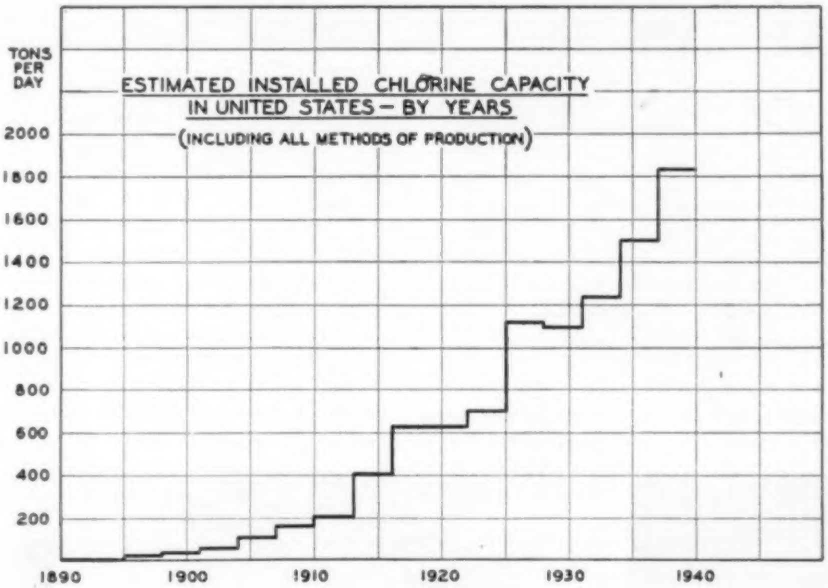


Fig. 4

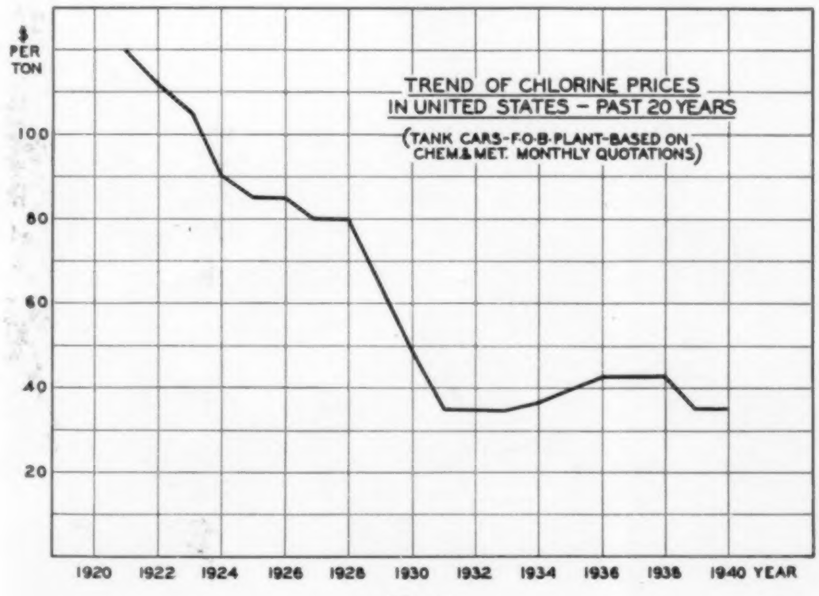


Fig. 5

Perfect Fits for

HAROLD S. CARD *Consulting Engineer, New York, N. Y.*

Chem. & Met. INTERPRETATION

A great deal has been published on the technique of welding of pressure and other vessels for process industries use, possibly giving the erroneous impression that with proper welding assured, the other phases of vessel fabrication are relatively unimportant. This is far from true for good welding cannot offset poor preparation and fit-up, which may result at best in a poor appearing vessel, and at worst, in one which is unsafe under pressure owing to eccentricity and the development of unanticipated stresses. This article reports how one large fabricating plant insures a perfect fit-up.—*Editors*

SOME YEARS AGO an ambitious attempt was made to weld an extensive installation of stainless steel piping. After a few months of service the installation fell apart although the welds were all intact, thus proving that stainless steel could be welded but that something was wrong. That "something" turned out to be carbide precipitation in the parent metal near the weld. In the following years a great deal has been learned and written about this important factor in the welding of stainless steels, not only for piping but for all manner of containers. The well informed fabricator now has little or no trouble from this cause. This discussion will therefore deal sparingly with the actual welding and focus attention on some mechanical aspects of the fabrication program, with particular reference to alloy vessels whose service conditions call for a perfect job.

If we assume a perfect fabrication to be one that will operate indefinitely in its service range without failure, we have a concept of perfection which is sufficiently rigid for the present purpose. At the bottom of the scale, for example, are ordinary water tanks and steel storage bins, which can readily be made to meet mild corrosion conditions by following directions that any electrode manufacturer can supply. For such purposes, much of the costly precision work in preparation which is to be described would undoubtedly be uneconomical.

At the top of the scale are alloy pressure vessels for the process industries where temperatures, pressures and corrosion conditions are so severe that extreme measures must

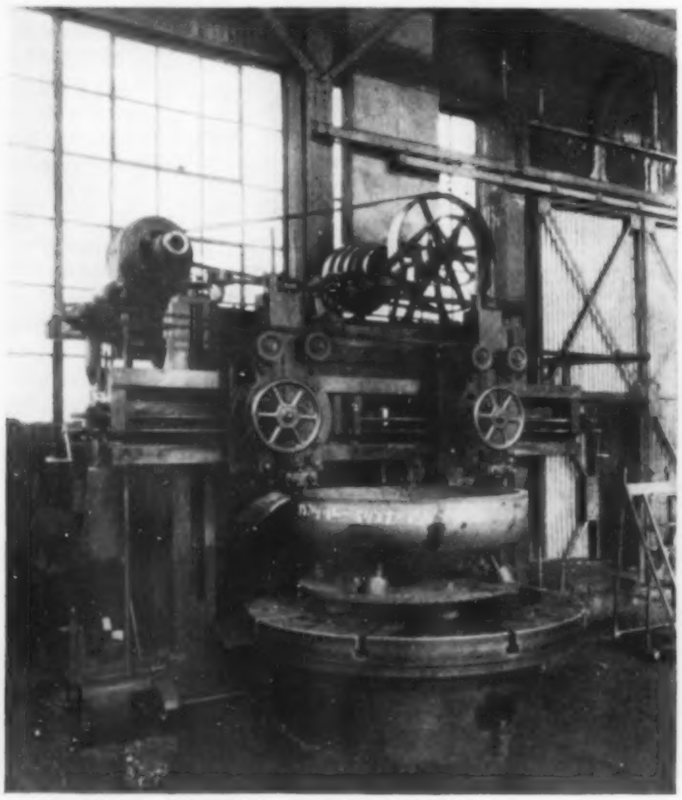


Fig. 1—On this boring mill the dished head is cut to size and the 35-deg. bevel for welding is formed

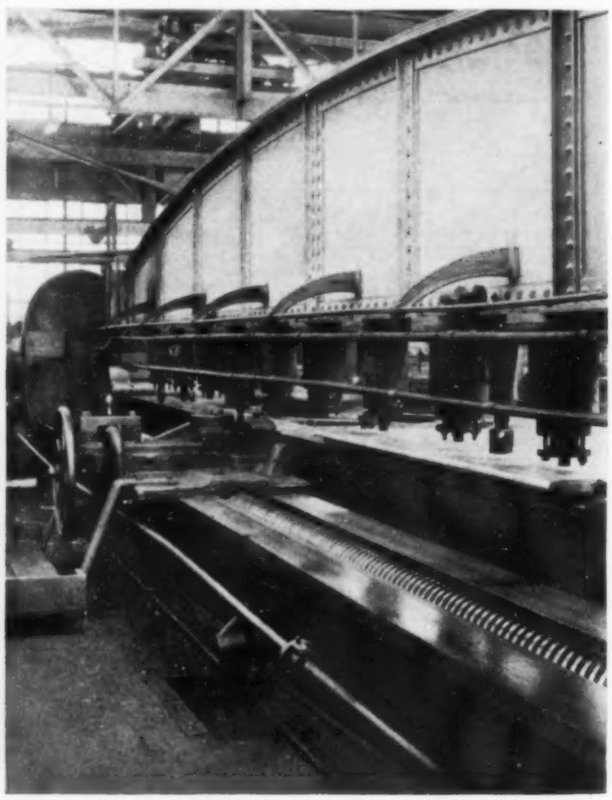


Fig. 2—The edge planer is an extremely accurate tool for trimming the shell plates to the exact size required

Perfect Welding

Photos supplied by Edge Moor Iron Works, Inc.

The hydraulic crimping press at the right (Fig. 3) is used to form the metal at the edges of the plate adjacent to the longitudinal seams before the plate is rolled to the desired finished diameter on the roll at the left (Fig. 4)

be taken to insure safe performance and long service life. Here every operation involved in manufacture must be performed with more precision and more carefully engineered control than is necessary to meet the mild requirements of appearance and sanitation, or simply resistance to corrosive action. The writer has had an opportunity to observe the fabrication procedures followed in the plant of Edge Moor Iron Works, Inc., at Edge Moor, Del., and through the courtesy of company officials is permitted to describe them.

The fact practically all of the vessels fabricated in this plant are subject to code requirements is sufficient to indicate that materials, operators and deposition techniques used are all of the first order. Furthermore, these are details of the process qualification that governs weld quality. Let us then give attention to the subject of fit-up, which is occasionally mentioned in connection with alloy fabrication, but is rarely discussed in any detail. There is, in fact, some thought that a good fit-up is accomplished chiefly by mounting the work in a jig that is strong enough to force plate edges into alignment before starting to weld. In the Edge Moor fabricating division a good fit-up starts much farther back than that.

For the sake of brevity, let us take the simplest case, a pressure vessel composed of cylindrical rings and dished heads. The plates for the head and shell are customarily ordered from the same heat, the shell plate being delivered flat and the heads following after they have been formed. (This, it should be noted, is a perfectly normal and routine delay.) When the shell plates arrive at the plant, the first step toward getting a perfect fit-up for this class of fabrication is to set them aside and wait for the delivery of the heads. This is necessary because the tolerances commonly allowed in the dimensions of formed heads are greater than the permissible fit-up tolerance, assuming that the finished vessel is to measure up to the definition already given of a perfect job.

Upon arrival, the dished heads are machine beveled on a boring mill (Fig. 1) to provide the welding groove. A 35-deg. bevel is the usual practice. Then the perimeter of the edge is taped to obtain exactly the right dimension of shell to fit it. This procedure is a thorough safeguard against offset joints. It frequently happens that two heads of the same intended size will turn out to vary slightly in diameter. Such variation is discovered at this stage of the fabrication and shell diameters are adjusted to compensate for it; the small amount of taper given to the shell being far less objectionable than a poor fit at the welding edge.

Next comes the shell plate preparation. This starts with the mill order, which has ¼ in. added to all four edges above the net size required. When the final dimensions have been determined from the head measurement, the plate is laid out, resquared and the edges are planed as in Fig. 2 and at the same time beveled (35 deg.) for the welding groove. (The chromium and nickel alloys of course require a harder tool and slower cutting speeds than boiler plate.) The depth of cut is more than ample to get below any surface cracks that may have been produced in shearing, and so there is obtained a sound and solid base for the weld deposit. Gas flame cutting is not used on this material, because of its crystallizing effect.

A careful check of the dimensions of the machined plate is made, then it is considered to be ready for forming. Prior to the rolling shown in Fig. 4, a powerful hydraulic crimping press (Fig. 3) forms the metal adjacent to both edges of the longitudinal seam to the radius of the vessel. This prevents the out-of-roundness which occurs if plates with flat edges are rolled to cylinders. A small curvature allowance is made in this pre-forming operation so that contraction of the weld area will draw the plate in to the exact curvature. Skill in the design and construction of forming dies thus becomes an important factor in obtaining fit-up.

The justification of all this meticulous attention is two-fold. In the first place, the welding of this material requires very skillful arc manipulation, which would be appreciably disturbed by variations in the width and shape of the welding groove.

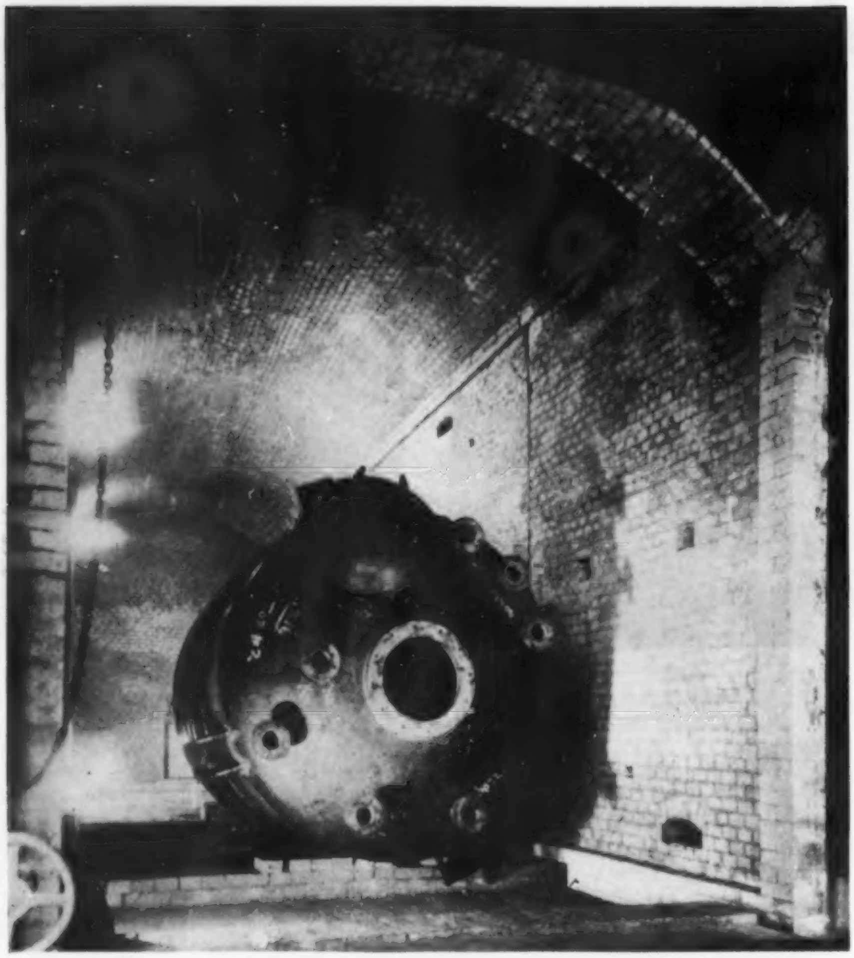


Fig. 6—Heat treatment for correcting carbide precipitation is accomplished after careful procedure determination based on a study of optimum heating rate

Secondly, it is obvious from a glance at Fig. 5 that offset joints produce uneven stress distributions. If the two defective procedures illustrated in Fig. 5 are combined in a single vessel the result is an ungainly and probably untrustworthy construction.

The practical view of all this is that we are considering the fabrication of vessels involving large quantities of expensive material. Economy dictates the use of the smallest sections that will carry the loads. Sound weld metal, smooth contours and easy stress distribution are all indispensable factors when minimum plate thickness is used. Certainly the last two of these essentials cannot be obtained with poor fit-up, and even the soundness of the weld would be open to suspicion by a skilled inspector wherever he detected misalignment.

After rolling to shape, the shell ring is tack welded rigidly and the longitudinal seam is welded. Then the ring is fitted to the head. If there have been no errors in the procedure thus far, the perimeters of the abutting edges should be identical in size and shape, but if any slight variation in curvature is discovered it can be corrected on the rolls before tacking on the head for final assembly.

Although the emphasis has been placed on these mechanical details of fabrication, it is not desired to underestimate the importance of the welding technique. The argument is rather that the careful development of welding technique is likely to be futile in proportion as these mechanical details are neglected.

When definite assurance of weld soundness is wanted, X-ray examination is used in the same manner as for boiler drums and other code vessels made from the carbon steels.

The favored method of correcting carbide precipitation is to heat to 2,000 deg. F. as in Fig. 6 and quench within three minutes from the time the heat is checked. The presence of heavy sections makes it a nice problem to determine the best rate of increasing the heat. Before heat treatment is started, therefore, a study is made to be sure that no part of the vessel is skimped, and in cooling special attention is again given to the heavy sections. If the vessel is too large for immersion a water spray is used for the quench. The use of columbium as a stabilizing element in chromium-nickel alloys is effective in preventing precipitation, provided that the columbium is present in both the plate material and the welding wire. Straight chromium alloys are heat treated to 1,550 deg. F. for three hours and allowed to cool slowly. The lighter gages of the 18-8 alloy are welded with a back-up of running water or dry ice, which checks warping as well as precipitation.

One property of the 18-8 group of alloys that is frequently overlooked is that it work hardens, and cold working may impair its resistance to corrosion to a considerable extent. A head that has been dished by hammering and then welded to a shell may oxidize quite readily out in the plate, even though the weld area is not greatly affected. A tank so fabricated should be heat treated in its entirety to restore its original metallurgical properties.

In the above discussion a simply designed stainless steel vessel has been used as an example, and only the simplest connections have been described. Many such vessels have more complex connections at openings, and more intricate interior components. There is therefore no end to the diversity of mechanical aspects of fabrication in this field.

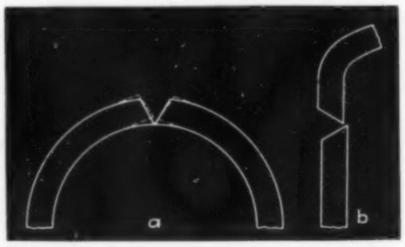


Fig. 5—Typical defective joints: (a) out-of-round, and (b) off-set joint

The necessity for good fit-up is equally great when plate materials are other commercial alloys, either ferrous or non-ferrous. New developments in the process industries are leading to demands for vessels fabricated from Monel, aluminum, copper, Everdur, etc., each material having its special deposition technique for the welding operator to learn. The universal requirement is for carefully engineered mechanical procedures to secure perfect fit-ups, in order that the welding technique may be applied with assurance of perfect success.

How an Acetate Rayon Plant Assures Fire Protection

M. BERNARD MORGAN *American Viscose Corp., Meadville, Pa.*

Chem. & Met. INTERPRETATION

Fire protection in a plant employing large quantities of flammable, volatile materials such as acetone necessitates a well-considered plan, suitable equipment, and constant vigilance in the maintenance of the efficiency of the protective installation. Mr. Morgan describes here how specially hazardous locations in the Meadville acetate rayon plant have been protected by carbon dioxide, piped to 12 of the process spaces, and automatically controlled by an ingenious electrical-mechanical system. A manually controlled carbon dioxide system, hand extinguishers and sprinklers are also used.—Editors

In the manufacture of cellulose acetate yarns in our Meadville, Pa., plant we are faced with fire protection problems which call for specialized extinguishing technique. In many of the process rooms and spaces where we prepare solutions of cellulose acetate with acetone and other volatile liquids, the air can become contaminated with a combustible mixture, because of acetone's 35 deg. F. flash point. This hazard exists in all seasons of the year and a static or electrical spark can touch off a serious and rapidly spreading fire.

To combat this hazard in the spaces where contamination with combustible fumes is most likely to occur, we have installed high-pressure carbon dioxide fire extinguishing systems. Their function is to provide, within a few seconds after ignition of vapor mixture, an atmosphere inert to combustion, and subsequently to retard or stop flame propagation to adjoining spaces. These systems have a total capacity of 5,500 lb. of carbon dioxide gas and liquid and form what is probably the largest gas fire extinguishing set-up used in any American chemical plant. They are supplemented by another 2,000 lb. of carbon dioxide stored in portable extinguishers, which can be used on localized fires in flammable liquids or electrical equipment when they are discovered in early stages.

Our largest carbon dioxide system consists of 94 cylinders, each of 50 lb. capacity which, together with the release mechanism, are housed in a small brick building specially designed for this purpose and located close to the hazardous spaces in the main plant. This system protects 12 process rooms or spaces, the control being arranged so as to give protection in the following manner:

Five spaces each to receive the contents of 94 cylinders.

Five spaces each to receive contents of 70 cylinders.

Two spaces each to receive contents of 24 cylinders.

This arrangement was based on the cubage of the various rooms and provides for an automatic discharge of enough gas to bring the oxygen content of the air in the spaces down to 14 per cent or less—well below the combustion point. In the event of fire in any one of the spaces, the discharge of gas provides an inert atmosphere not only in the room where the fire starts but in adjoining spaces, inasmuch as flash fires can spread to all adjoining spaces.

Control for the 84-cylinder installation is mechanical-electrical, and is actuated when an abnormal rate of temperature rise occurs in any space. Air-filled actuators are located on the ceiling of each space as in Fig. 1, and are connected through small-bore copper tubing to a trip mechanism which opens the cylinder valves and floods the space where the tempera-

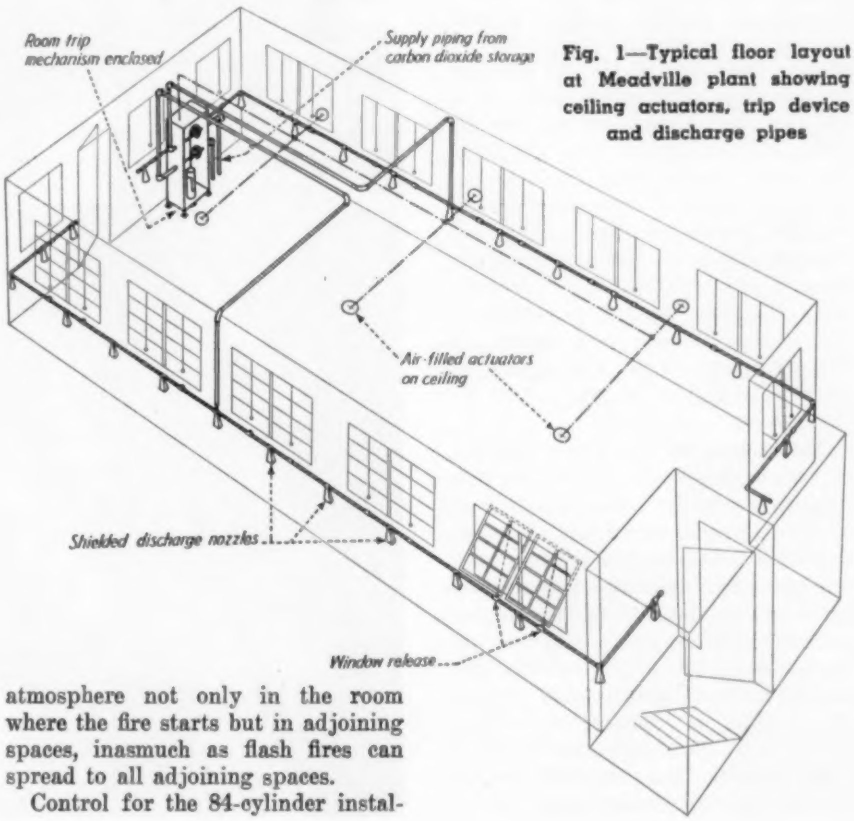


Fig. 1—Typical floor layout at Meadville plant showing ceiling actuators, trip device and discharge pipes

ture rise occurs, as well as adjoining spaces. Thus, a rise in temperature in any protected space causes a rise in air pressure within the tubing, and while a gradual temperature rise from weather changes is discounted by an orifice, a sudden temperature jump actuates a diaphragm and releases the trip mechanism. When this mechanism is tripped it allows a weight to fall, turning a distribution valve and simultaneously closing a switch in an electrical circuit to the cylinder house. A magnetic release in the cylinder house opens valves on four of the carbon dioxide cylinders, and with the impact of this discharge the valves on the remaining 90 cylinders are opened through a cylinder and piston mechanism.

Because of the importance of the electrical control circuit, current is supplied by a storage battery connected with a continuous trickle charger. A loop arrangement is used for the control circuit, and both sides of the switches, which are located in various hazard points, are continued in series and closed through a magnetic holding switch on the trouble-bell circuit, which in turn is energized by dry cells. Failure of the control circuit current for any reason is thus made evident by the ringing of the trouble bell.

In the event of fire, the carbon dioxide is carried to the proper space by the distributing valves and moves through a piping system located around the walls of the protected space. Discharge of the gas into the room is almost instantaneous through its own stored pressure of 800 to 2,000 lb. per square inch—a pressure which varies with the temperature. It enters the rooms through shielded nozzles on the piping system and floods the entire space from floor to ceiling within a few seconds after the first sudden temperature rise occurs. Flame propagation is thus stopped and the atmosphere in all nearby spaces is made inert to combustion.

The factors which led to our choice of carbon dioxide fire protection can be seen from the above description of how the gas functions. Because the combustible mixture hazard in our plant produces three-dimensional fires, we felt that a three-dimensional extinguishing medium should be used. Also, the ability of the gas to blanket flammable liquids despite obstructions is another important point, as is the speed with which a room can be flooded with carbon dioxide despite sudden and severe flash fires or explosions. Our choice of automatic release for the gas, which of course is supplemented by manual control, is dictated by the need of eliminating the human element in combatting combustible vapor fires.

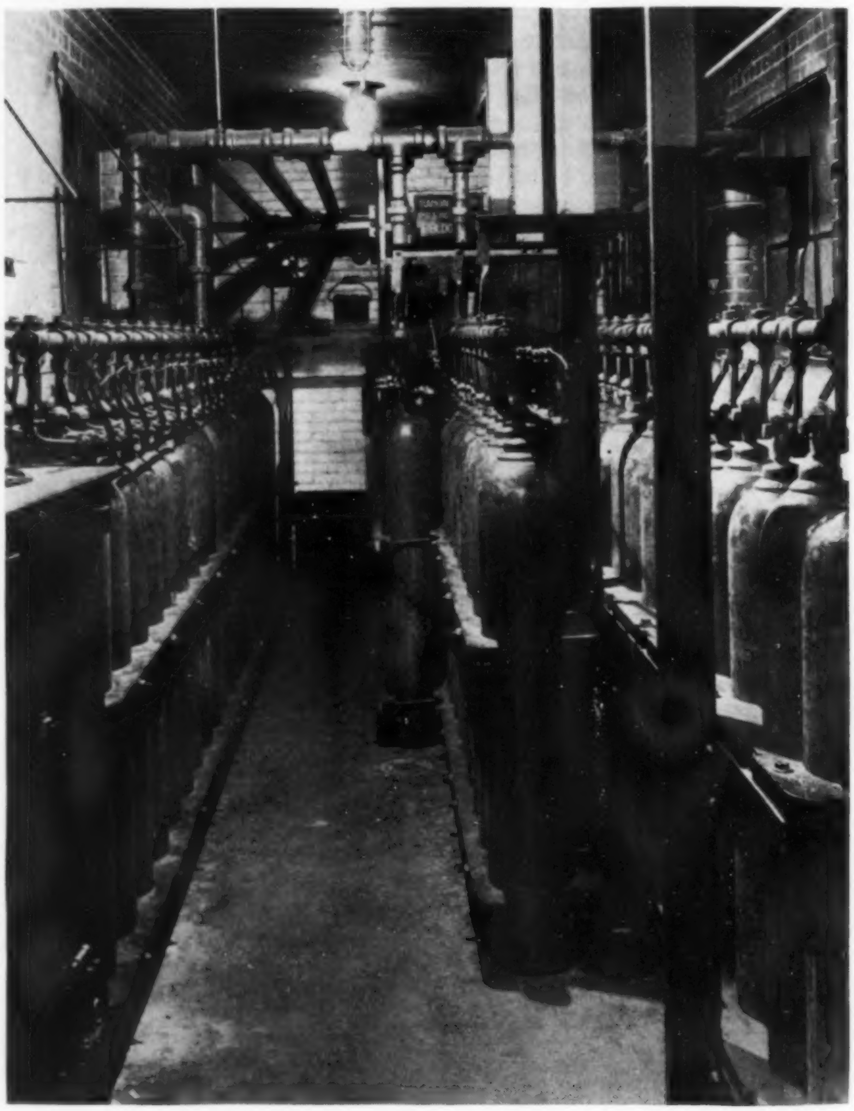
Once the gas is released into a series of spaces, it is necessary to prevent its escape, and the many windows in our plant, which are kept open for auxiliary ventilation, had to be provided with automatic closers. This was accomplished by trip mechanisms located in the piping system at every point where the piping system passed under a window or near a door. Windows are weighted to keep them normally closed and may be held open only by looping a ring and chain pull over a pin in the trip. When the released gas goes through the piping system, the pins are automatically retracted and the windows and doors are closed.

A 16-cylinder installation, which protects a number of smaller areas where similar hazards exist, functions in the same manner and is used to flood completely the process rooms and provide an inert atmosphere. Because of the layout of these areas a mechanical rather than an electrical control is used and this system is located in the plant itself rather than in the cylinder house mentioned above. An inclosure (see Fig. 3) protects both the cylinder battery and the trip mechanism to prevent tampering and interference with weight movements.

Inspection Test Routine

With great responsibility resting on such a fire extinguishing system the equipment must be kept in perfect mechanical condition and for this

Fig. 2—Interior of brick cylinder house where 94 carbon dioxide cylinders of 50 lb. capacity are stored to supply gas for the flooding of 12 processing rooms



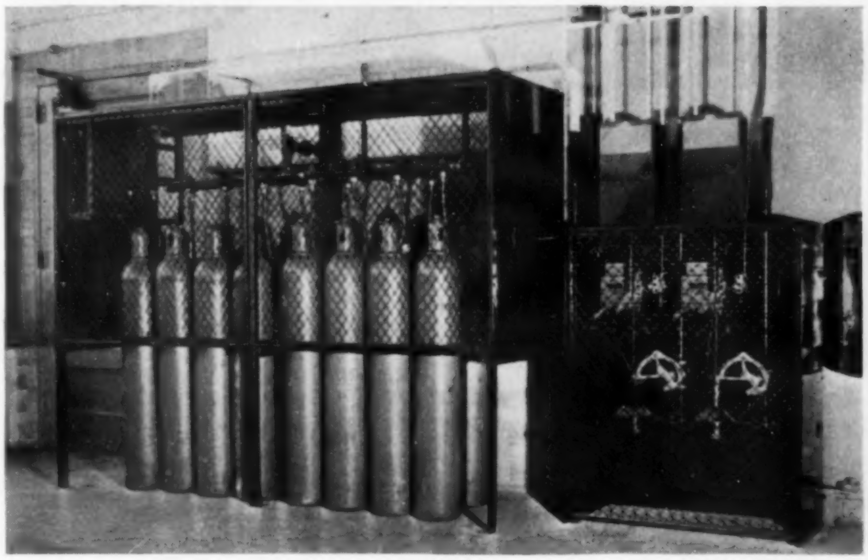


Fig. 3—This 16-cylinder manual control system is located in the plant proper for protection of certain smaller areas

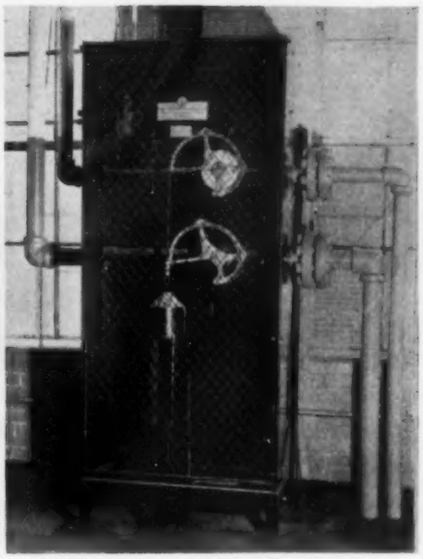


Fig. 4—Close-up of automatic trip mechanism which operates valves to distribute gas to the proper room

reason we have a regular inspection routine. Every 24 hours the trip devices receive a visual inspection. Once a month the storage battery and trouble-bell circuit is tested and inspected. Every three months a heat test is conducted in one of the process rooms to see that a sudden rise of temperature will trip the system at the proper setting. Every five years the entire piping system is blown out to clean out any scale or dirt that may have collected in the piping. This inspection, together with a weekly inspection of all other fire-fighting apparatus and fire doors, is recorded on a form which goes to the plant engineering department. Any defects or hazardous conditions are thus reported immediately and steps are taken to correct them.

Portable Fire Extinguishers

Another total of nearly a ton of carbon dioxide is deployed throughout the plant in the form of portable units, in order to smother fires in their early stages and to forestall operation of the main systems and sprinklers wherever possible, thus preventing water damage and interruption of production. These extinguishers, which consist of the same basic type of steel cylinder equipped with a hose and discharge nozzle, include 100 extinguishers of the 15-lb. size; 9 of 50-lb. size; 2 of 2-lb. size and 1 of $7\frac{1}{2}$-lb. size. These carbon dioxide extinguishers are located at points where they can easily be seen and are accessible to any employee who might discover a small fire. On many occasions these handy units have been very useful in stopping a blaze before it reached dangerous proportions, and before the fixed extinguishing system could go into action.

Also located throughout the plant are 300 soda-acid extinguishers for fighting fires in carbonaceous materials, and a few carbon tetrachloride units are also located in the plant.

Sprinkler System

Throughout the Meadville plant is a complete sprinkler system for general protection of the buildings proper and for rapid cooling of any combustible materials that might be involved in a fire, regardless of type. It is well known that the effectiveness of automatic sprinklers over flammable liquids depends on the flash point, temperature, and the quantities of the liquids involved, but when working with liquids of low flash point they should not be considered as complete protection in themselves. This is, of course, why our most hazardous operations are protected with carbon dioxide.

Our primary water supply for the sprinkler system is furnished by a 150,000-gal. storage tank at an elevation of 150 ft. A secondary source is supplied by two centrifugal fire pumps, each rated at 1,500 gal. per minute at 100 lb. per square inch gage pressure. Both are automatically controlled by line pressure, with the controls arranged so that the steam-driven pump cuts in first, followed by the motor-driven pumps if the line pressure continues to drop.

The main distribution system for the sprinklers consists of 7,000 ft. of 10-in. underground piping, which loops around the entire plant. Twelve sectional cut-off valves enable any one of the eleven sections to be cut out of service for repairs without interrupting service on the remaining sections.

From this underground main, 32 risers of 8-in. and 6-in. sizes serve the 18,000 sprinkler heads in the plant. Each riser is provided with a post indicator valve for quick shut-off after an emergency or for repairs. Also, hooked to the main sprinkler system is a drypipe sprinkler which protects an unheated lumber storage building. The main also supplies 21 triple outlet hose hydrants, all of which are inclosed in housings which contain hose, nozzles, axes, lanterns, wrenches, etc.

In addition to the mechanical equipment outlined above, we also feel that knowledge of first-aid fire fighting is extremely important to continued production, and our employees are trained in basic fire-fighting methods. In a plant handling the combustible liquids which form such a vital part of our processes, the importance of good housekeeping and constant alertness to prevent small fires from reaching dangerous proportions cannot be overestimated. Any one of the small fires which we have had could easily have got out of control had it not been for this alertness and knowledge. Where the objectives are to eliminate production interruptions and to safeguard lives, this combination of complete extinguishing equipment and thorough knowledge of its use has proved extremely successful.

Further Improvements in Drum Construction

Chem. & Met. INTERPRETATION

Somewhat in the nature of a progress report, this article is related to one which appeared in *Chem. & Met.* two years ago and which gave the results of tests on a new type of 55-gal. steel drum with 20-gage sidewalls and 18-gage heads. Acceptance of the new drums by manufacturers and shippers resulted in considerable savings; favorable comments were received from most users. A few complaints and adverse comments were the reason for the investigations and recommendations reported here by the Joint Conference which conducted the test program. — *Editors.*

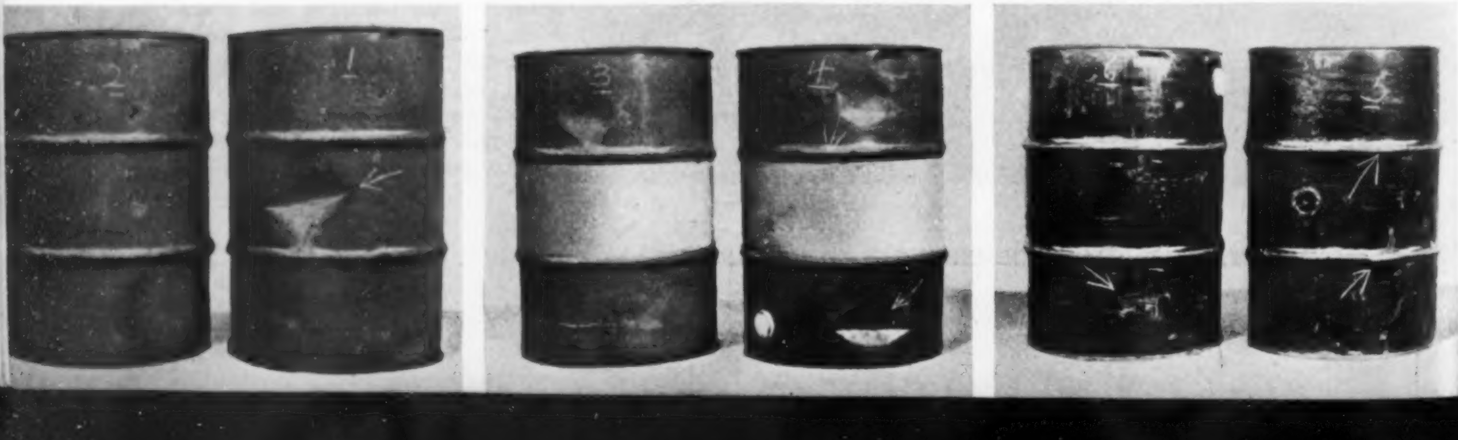
IMPROVEMENT in the quality and utility of the modern container has kept pace with the continually increasing fund of research achievement and scientific knowledge. The present 55-gal. I.C.C. 5E drum with 18-gage heads and 20-gage sidewall, authorized for the transportation of non-dangerous liquids as well as flammable liquids with flash point between 20 and 80 deg. F., stands out as an example of contained improvement developed through intensive experimental work and cooperative effort.

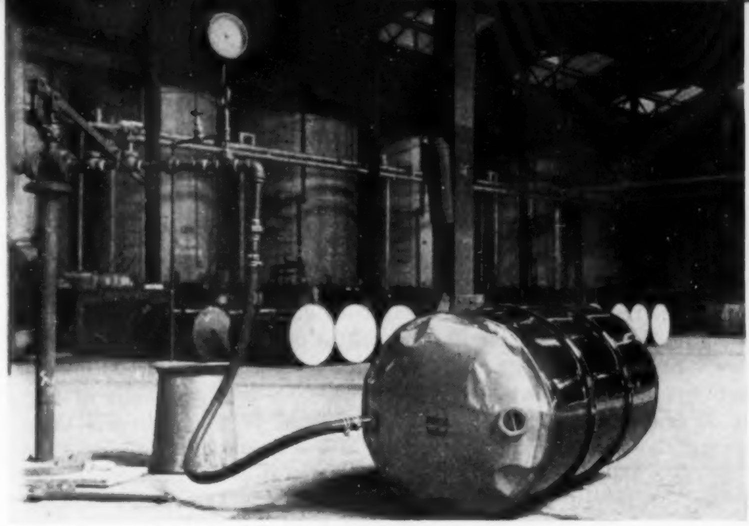
Transportation of flammable liquids in 55-gal. single-trip drums had its inception on April 16, 1931, when the Interstate Commerce Commission approved an application of the Manufacturing Chemists' Association for authorization of the 5E drum of all 18-gage construction. Prior to this time, returnable drums, Spec. 5 and 5B, of all 16-gage construction had been used. Because of the convenience and attractive savings possible for the consumer through use of the new single-trip container over the returnable type, its adoption by the alcohol, solvent, paint and petroleum industries was immediate and an estimated annual production of 6,000,000 drums was attained by 1938. The Steel Barrels and Drums Committee of the Manufacturing Chemists' Association, which pioneered the new drum, continued its development work and in 1934 published quality studies on 18-gage 5E drums purchased from ten drum manufacturers. (*Chem. & Met.,* Dec. 1934, p. 648.) The studies included tabulations of hydrostatic pressure tests, drop tests, weight tests, measurement of head convexities and double seam tests.

Extensive use of the new I.C.C. 5E drum by members of the chemical industry, coupled with constant experimentation and test conducted by the M.C.A. Steel Barrels & Drums Committee, ultimately indicated that the all 18-gage container was unbalanced in strength in that the sidewalls were stronger than the heads. The excellent transportation record of the drum with no recorded instances of head failure suggested the possibility of a reduction in the gage of the sidewall metal to bring it more nearly into balance with the strength of the heads. A series of comprehensive tests were then carried out by the Steel Barrels & Drums Committee in order to determine the effect of the substitution of lighter gage steel in the sidewalls. (*Chem. & Met.,* July 1938, p. 366.) These tests showed that 20-gage sidewall drums were safe and adequate containers although they appeared to be somewhat more susceptible to denting than those of all 18-gage construction and to flatten the swedged-out rolling hoops somewhat when under sustained heavy internal load. Following an analysis of the test results, application for authorization of the 20-gage sidewall drum was filed with the regulatory bodies. The applications were approved effective July 1, 1939, I.C.C. Specifications 5E being amended to permit the use of this drum as a single-trip container for flammable liquids flashing between 20 and 80 deg. F., and Sec. 5C, Rule 40 of the Consolidated Classification changed to permit the use of the 20-gage sidewall, bung-opening drum under the same conditions as formerly obtained for the all 18-gage. Users of the 20-gage sidewall drum were then able to take advantage of the material savings involved, these savings being a combination of reduced drum cost and savings on freight expense, overall economies being considerable and of great advantage to the shipper.

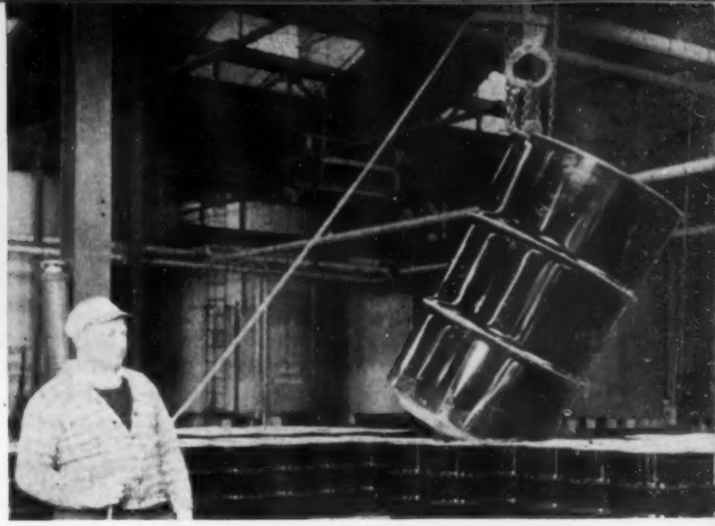
Recent extensive use of the newly authorized 20-gage sidewall I.C.C. 5E drum has confirmed the committee's judgment as to its adequacy and general utility. Such adverse comment as has been received has been based

Condition of drums of various yield point steels after shipping tests. Yield points of steels in the three pairs of drums shown were: left, 39,800 lb.; center, 27,000 lb.; right, 48,300 lb.





Hydraulic test apparatus used to determine resistance of drums to internal hydrostatic pressure



Drop test, filled drums are allowed to fall onto concrete floor simulating rough handling during shipment

primarily on appearance, due to some flattening of the rolling hoops and denting, caused by rough treatment and overweighting the drums. Several substantial users reported satisfactory results. Denting of the drums, particularly those used by the alcohol industry for anti-freeze products, was considered objectionable because it detracted from the appearance of the lithograph and color work used by certain manufacturers. It may be noted, however, that denting was not uncommon with the all 18-gage drum.

In order to study this problem most effectively, a joint committee was appointed, made up of representatives of the Steel Barrel Manufacturers Council, independent drum manufacturers and the Steel Barrels & Drums Committee of the Manufacturing Chemists' Association. Investigation of some of the complaints revealed: (1) steels were too soft and were not true to gage; (2) existence of a certain amount of faulty welding, double seaming and improper shaping of swedged-out rolling hoops; (3) drums were improperly stored, handled and loaded by shipper's employees. The drums that were made immediately following the authorization of the 20-gage I.C.C. 5E drum were more subject to denting than those made at a later date, and it was shown that in some cases relatively soft steels, with yield points ranging between 20,000 and 24,000 lb. per sq. in. were used in fabricating these drums.

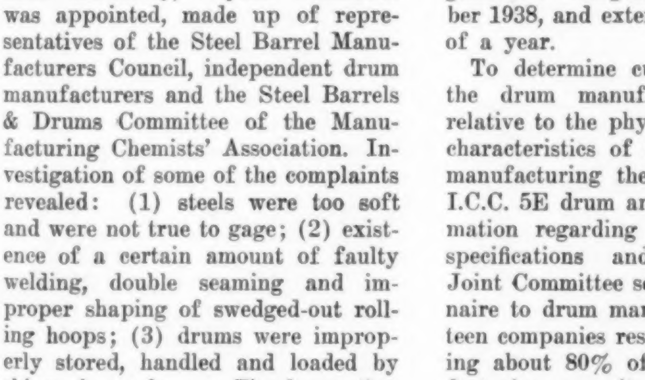
The Joint Committee prepared a test program which included the following items of study: (1) physical and chemical characteristics of the steels used, and fabricating technique; (2) effect of yield point of steel on the stability of swedged-out rolling hoops; (3) effect of yield point upon resistance to denting and weaving; and (4) service tests to compare the 20-gage I.C.C. 5E drum of stiff steel with the all 18-gage I.C.C. 5E drum fabricated from ordinary soft steels. The test program was inaugurated during October 1938, and extended over a period of a year.

To determine current practice in the drum manufacturing industry relative to the physical and chemical characteristics of the steels used in manufacturing the 20-gage sidewall I.C.C. 5E drum and to obtain information regarding drum fabricating specifications and technique, the Joint Committee sent out a questionnaire to drum manufacturers. Eighteen companies responded, representing about 80% of the drum manufacturing capacity of the industry. Replies to this questionnaire were summarized, tabulated and distributed to members of the Joint Committee and to all cooperating drum manufacturers.

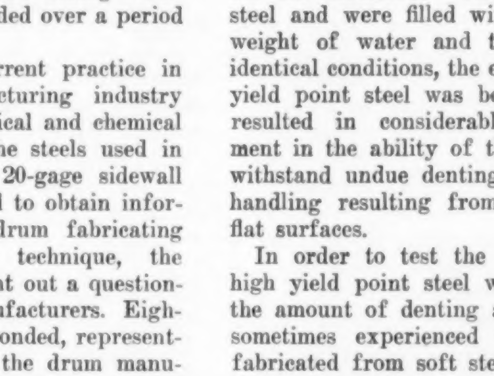
Tests were conducted to show the effect of yield point of steel on the ability of rolling hoops to withstand crushing or flattening. Drums of regular I.C.C. 5E construction having 20-gage sidewall, with yield points of 33,000 and 49,000 lb. per sq. in. were filled with water and rolled 200 ft. on a concrete surface. Sections were then cut from the drum sidewalls at the rolling hoops, and photographs made. With drums of lower yield point steel, a decided flattening of the hoops was observed. With those of higher yield point, very little crushing effect was noted, indicating that although the drums were of identical construction except for the hardness or stiffness of the steel and were filled with the same weight of water and tested under identical conditions, the effect of high yield point steel was beneficial and resulted in considerable improvement in the ability of the drums to withstand undue denting and severe handling resulting from rolling on flat surfaces.

In order to test the theory that high yield point steel would reduce the amount of denting and weaving sometimes experienced with drums fabricated from soft steels, a lot of 700 drums, fabricated with special 20-gage cylinders of the highest yield point steel obtainable, was purchased by one of the cooperating companies. These drums were tested, filled and shipped to customers in order to compare them with drums made of 20-gage soft steel sidewalls.

Condition of drums after racking tests. Yield points of steels were: left, 50,000 lb.; right, 27,000 lb.



Test to determine sidewall resistance of drums by rolling and by impact



Results clearly demonstrated the superior qualities of high yield point steel. Of the many comparative test shipments made with drums of both low and high yield point sidewalls, a typical test report is given in Table I.

Additional drums were shipped l. c. l. freight from Linden, N. J. to Pittsburgh, Pa. and return. The trip involved several transfers and truck pick-ups. Results of this test are given in Table II.

Two 20-gage sidewall drums with yield point between 22,000 and 27,000 lb. and two similar drums with yield point of approximately 50,000 lb. were filled and placed on a regular steel track drum rack and allowed to stand for two hours. The rails on the rack were ¾ to 1 in. wide and contacted the drums at a point about three inches from the rolling hoops toward the drum chimes. The drums fabricated with the stiff steel were not dented after removal from the rack, rolled very easily on the rack and did not sag. The drums fabricated from the regular soft steel were dented and rolled along the rack with difficulty. Another comparative test to determine the resistance of various types of drums to denting was conducted on an 18-ft. horizontal skid with 1-in. rails, the latter being 20¼ in. apart from center to center thereby contacting the drum shells between the rolling hoops and chime. The drums were filled with water and slowly rolled by hand a distance equivalent to 30 drum circumferences. Results showing the superior qualities of the 20-gage sidewall of high yield point steel are given in Table III.

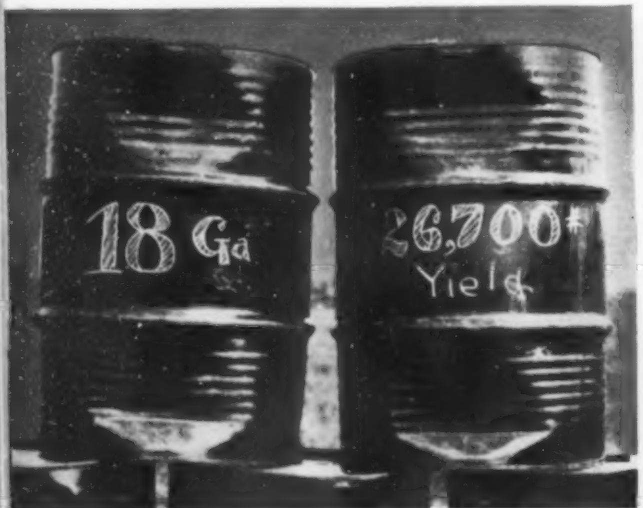
A carload of I.C.C. 55-gal. 20-gage sidewall drums were filled and shipped from Pittsburgh to St. Louis, Mo. Sixteen of the drums had sidewalls manufactured from stiff steel (approx. 50,000-lb. yield point) and the balance were fabricated from ordinary 20-gage steel. The following report was received from the customer: "The general appearance of the new drums (stiff steel) is much better than the old (softer steel); there were no rolling hoops flattened on the new drums, but there were some on the old. The new drums had no dents, whereas the old had several, and none were badly damaged."

Another lot of 15 drums containing net weights of about 450 lb. were shipped by truck to the eastern seaboard, boat to the west coast, truck or rail to destination and then truck delivery to customer. Twelve of the drums had 20-gage sidewalls of 50,000 lb. yield point steel, and three with 20-gage sidewalls of 22,000 to 27,000 lb. steel. The 12 stiff drums were received in excellent condition, there being not more than one or two minor dents per drum, whereas the three drums made with ordinary sidewalls contained many more and larger dents, and in one case, was completely out of round. The examiner's report on the stiff drums of 50,000 lb. yield point follows in part: "The general appearance of the barrels was excellent. There were very few dents in the swedge, body or head of any of the barrels. The swedges were in excellent shape. There was no flattening or collapsing."

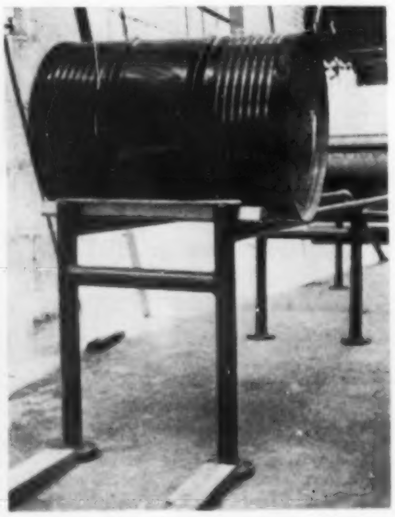
Several thousand drums made of 20-gage sidewalls of 35,000 to 40,000-lb. yield point steel were purchased by cooperating companies and placed in regular service. No complaints were received from customers on these drums and no trouble developed. An additional lot was then purchased with sidewall yield points ranging

Table I—Test report on a carload of 55-gal., 20-gage steel drums shipped from Pittsburgh, Pa. to Linden, N. J.

				Condition of Drums					
Lot No.	No. of Drums	Contents wt, lb.	Yield Point	No dents	Slight dents	Bad dents	Sides flat	Condition Hoop	Remarks
1	5	406–422	22,000 to 27,000	4	1			slightly flattened	good
2	7	440–446	22,000 to 27,000		3		4	slightly flattened	poor
3	8	408–439	22,000 to 27,000		7	1		slightly flattened	fair
4	5	400–423	22,000 to 27,000		3	1	1	slightly flattened	fair
Total	25			4	14	2	5		
5	12	450–459	50,000	8	3		1 (slight)	O.K.	excellent
6	10	431–450	50,000	10				O.K.	excellent
Total	22			18	3	0	1		



Condition of a pair of drums after being filled with alcohol and subjected to the drop test



Equipment used to determine drum wall strengths by dropping tests

Table II—Test report on l.c.l. shipment of drums with 20-gage steel sidewalls; net weight of contents, 444 lb.

Wall hardness (Rockwell B)	Wall yield point	Condition after return
52	39,800	1 small and 1 large dent on side. Hoops slightly flattened.
52	39,800	Few small dents in side. Hoops slightly flattened.
soft	27,000	5 dents in side. Hoops flattened.
soft	27,000	7 large dents in sides. Hoops flattened.
69	48,300	2 dents in side. Hoops slightly dented.
69	48,300	3 dents in side. Hoops O.K.

Table III—Results of rolling tests

Sidewall gage	Approximate yield point	Condition after rolling
20	45,000	Excellent. Practically no denting.
20	25,000	Poor. Considerable denting even after first revolution.
19	39,000	Very little denting but not as resistant as no. 1.
18	25,000	Fair. Not as resistant as no. 3.

Table IV—Results of dropping tests

Sidewall gage	Yield point	Average tare, lbs.	Net wt. contents, lb.
18	26,700	51.7	354
20	35,000	40.2	369
20	46,000	41.4	369

between 40,000 and 45,000 lb. per sq.in., filled with ladings averaging 450 lb. net and shipped to customers. These drums proved to be more resistant to denting and rough usage than the preceding lot and led to the conclusion that drums made from sidewalls of 35,000 to 45,000 lb.-yield point are satisfactory for the commodities authorized for shipment therein.

In order to prove the relative stability of 20-gage side sheet drums of high yield point in comparison with all 18-gage drums of a lower yield point, three types of containers were procured. (These are listed in Table IV.)

Twenty-one each of these drums were loaded with alcohol and rolled 200 feet on concrete. They were then dropped from a height of 31 inches on two pieces of 2-in.x4-in. lumber, the wider side being on the ground. The drums were dropped so that they would contact the wood on the side walls between the rolling hoops and chime. They were then shipped by truck to a point 90 miles distant, unloaded upon skids, and stored until used. After use, they were returned for inspection. Examination of the emptied drums showed that the indentation of the sidewalls and the rolling hoops of the 20-gage sidewall drums was no greater than that experienced by the all 18-gage drums fabricated from softer steels in spite of the fact that the net weight of contents carried in the lighter gage containers was 15 pounds greater than that contained in those of heavier gage.

As a result of the many tests conducted during the past year with drums fabricated from 20-gage sidewalls, the Joint Committee has concluded that a 55-gal. container is satisfactory as to appearance and to resistance from denting and flattening of rolling hoops can be provided by using stiff steels of adequate yield point. It must be reemphasized, however, that 20-gage sidewall drums fabricated from ordinary steels with yield points ranging between 22,000 and 26,000 lb. per sq.in. are adequate and safe for all of the purposes for which the I.C.C. 5E drum is authorized.

In recommending the drum to industrial users, the Joint Committee advised against overloading, issuing the following statement to that effect on Sept. 20, 1939: "The new I.C.C. 5E, 55-gal. drum with an 18-gage head and 20-gage sidewall has been widely used since its approval by the Interstate Commerce Commission. In developing the drum as a single-trip container, however, the Steel Barrels & Drums Committee of the Manufacturing Chemists' Association intended that it be used primarily for hazardous liquids of low specific gravity, such as alcohol and various solvents. This drum should not be overloaded, and the committee has recommended that the maximum net weight of contents shipped therein not exceed 450 lb. Better quality sheet steel is now available and improvements in design and fabrication have been made. It is expected that the I.C.C. 5E drum with 20-gage sidewall will be even more extensively used in the future."

ALKALI-CHLORINE DEVELOPMENTS

(Continued from page 399)

shipment of liquid caustic soda and a corresponding decrease in production and shipment of fused caustic soda in steel drums. By far the larger proportion of the caustic soda now used is shipped as liquid in 50 and 70 per cent or higher concentrations. An important factor in this trend towards liquid caustic soda has been the development of insulated and lined tank cars which retard solidification and do not contaminate the product during shipment. Much work has been done on linings for caustic soda tank cars to make this possible and heavily insulated cars for the higher concentrations are now in widespread use. An interesting caustic soda transportation development is Mathieson Alkali's Dolomite IV, a tank boat which is especially designed for transportation of high grade liquid caustic soda in nickel lined compartments. Large quantities of caustic soda have been transported in oil tankers for the past eleven years from the Pacific Northwest to the oil and soap industries in the San Francisco and Los Angeles areas.

Having reviewed the history and growth of the electrolytic alkali industry as a whole, attention will now be given to a development which has played an important part in the industry especially during the past five years, namely the development of the deposited diaphragm cell.

In 1925 K. E. Stuart of the Hooker Electrochemical Co. began work on the formation of an asbestos diaphragm intended, originally, for use in the Hooker type E (Marsh) cells. This conception led to the construction of a cell which, over a period of years, has developed into the present Hooker type S deposited diaphragm cell. Several others in the Hooker organization in addition to K. E. Stuart have contributed to the present satisfactory design. (For detailed description of the type S cell see *Chem. & Met.*, page 354, July, 1938.)

There are on the one hand direct benefits from the use of a deposited diaphragm and on the other indirect benefits resulting from the unique cell construction which the deposited diaphragm has made possible. Among the direct benefits may be listed the following:

1. Lower chlorates, and hypochlorites and better separation of hydrogen and chlorine resulting from the firm, close bond between the cathode and diaphragm.
2. Lower power consumption due to high ampere efficiency resulting from uniformity and quality of the diaphragm.
3. Lower diaphragm renewal cost resulting from the simplicity of renewal and the low cost of bulk asbestos fiber as against asbestos paper.

Among the indirect benefits from use of this type of diaphragm are:

1. Large capacity per cell resulting from the close packed arrangement of cathode and anodes made possible by the complex finger structures of the cathode which in turn is feasible only with the deposited diaphragm.
2. Lower operating and repair labor cost per unit of output due to the large capacity units and simplicity of their construction.
3. Lower investment cost in cells, cell building, fittings, piping and gadgets due to the large capacity units, simplified design and very large output per square foot of floor area.
4. Lower power consumption due to low voltage resulting partly from the close packed arrangement of cathodes and anodes, and partly from the high temperature at which the cell operates.
5. Heat conservation due to large anode area per unit of radiation surface area, and to the insulating property of the concrete top and bottom, all of which results in high caustic strength and low chlorates and hypochlorites in the cell liquor.
6. Low graphite consumption in spite of high operating temperature due to uniform distribution of current and large proportion of graphite which is active.

Heat Transfer Coefficients In Glass Exchangers

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ALAN S. FOUST *Assistant Professor of Chemical Engineering, University of Michigan, Ann Arbor, Mich.*

Wide utility for corrosive materials of double-pipe heat interchangers using the inner tube of Pyrex makes it desirable to know more accurately the heat transfer characteristics of such an exchanger. The original purpose of this research was the evaluation of the factors controlling the performance of such an exchanger in dehumidifying wet gas. Difficulties in correlating the results later dictated the addition of measurements of coefficients from water to water, and from steam to water.

Transfer of heat from a mixture of condensable and non-condensable gases to a cooling medium involves the flow of heat in series through the gas film, the condensate from the gas, the retaining wall and the cooling medium film. In the gas film, both the transmission of heat and the transfer of mass occur. A thorough investigation of this type of cooling was carried out by Colburn and Hougen[1]. Their measurements were made over a wide variety of conditions in a 3 in. x 7 in. x 7 ft. vertical double-pipe condenser with gas flowing in the annulus. Thermal resistances were measured for the gas film and the condensate layer. The temperature of the condenser wall was accurately measured by thermocouples.

Colburn and Hougen presented their results in the equations:

$$h = \frac{48\, V^{0.8}\, P\, P_v\, F}{M_g^{0.6}\, P_g}$$

$$K = 2.7\, \frac{V^{0.8}\, P\, F}{M_g^{0.6}\, P_g}$$

h = heat transfer coefficient, B.t.u./hr./sq.ft./° F.
K = mass transfer coefficient in lb./hr./sq.ft./in. of Hg partial pressure drop.
V = mass velocity, lb./sq.ft./sec.
P = total pressure, in. of Hg.
P_g = partial pressure of non-condensing gas, in. of Hg.
P_v = partial pressure of condensing gas, in. of Hg.
M_g = molecular weight of non-condensing gas.
F = entrance factor.

Based on a paper of the same title presented before the Buffalo meeting of the American Institute of Chemical Engineers, May 13-15, by the authors.

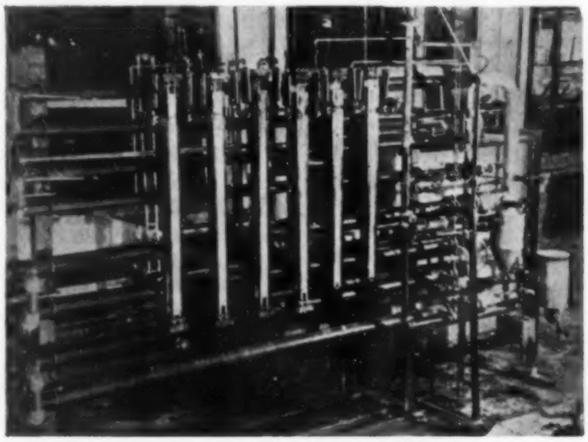


Fig. 1—Four pass double-pipe heat exchanger with inner tube of Pyrex glass; used for heat transfer investigations conducted by the authors at the University of Michigan

***Chem. & Met.* INTERPRETATION**

This article is intended to increase the fund of reliable information about the thermal characteristics of Pyrex glass in heat exchangers. It is based upon the results of investigations conducted at the University of Michigan for the Corning Glass Works. Of most significance are these facts: (1) with these data, performance of double-pipe heat interchangers may be accurately predicted under a variety of conditions; (2) surprisingly high coefficients are possible for dehumidification if the gas stream is flowing at moderately high velocities; (3) distribution of heat flux over four passes is uniform and (4) evidence indicates that thermal conductivities for pyrex are lower than published values. The increased use of glass as a construction material by the chemical engineer makes it imperative that he know its thermal properties.—*Editors.*

The usual exchanger, such as that studied in this investigation, differs from the Colburn-Hougen apparatus in three major respects: (1) it is horizontal; (2) it is normally longer, hence built in sections, or "passes"

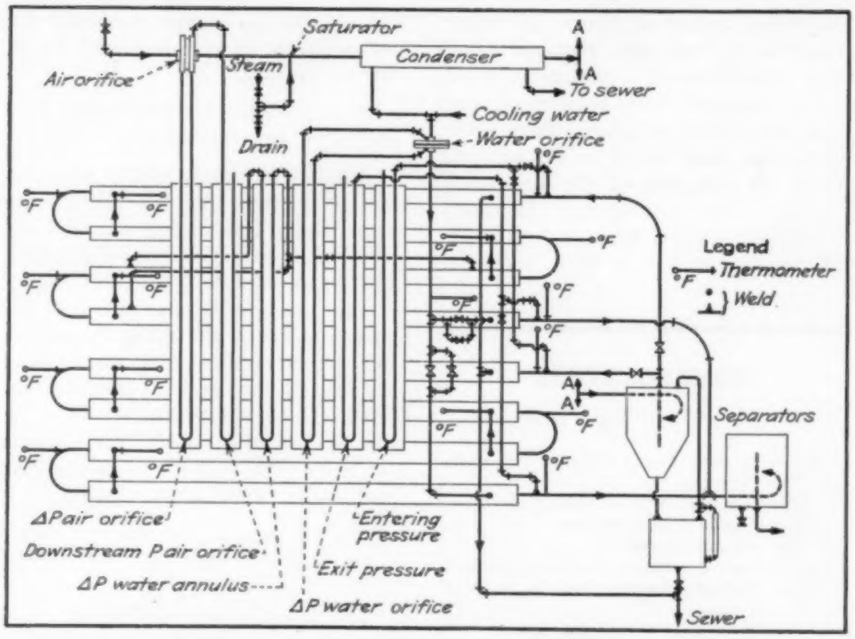


Fig. 2—Diagram showing the direction of fluid flow through the apparatus pictured in Fig. 1. Note that manometers are attached to the front of the exchanger, thereby hiding part of the piping. Thermometers are shown at several points

and (3) for corrosive gases or liquids, the cooling water, rather than the gas stream flows in the annulus. The inherent difference in the condensation characteristics on a glass surface rather than a metal surface may be important, as also may the lesser tendency of glass to become fouled.

Equipment—The apparatus, Fig. 1, built for this investigation, consisted of two double-pipe exchangers of four passes, each 10 ft. long, supported one above the other on a 3 in. angle-iron framework. One exchanger was standard 1 in. Pyrex heat exchanger tubing (0.06 in. thick) jacketed with standard 2 in. iron pipe; the other was 2 in. Pyrex (0.06 in. thick) in 3 in. pipe. The humidifying, separating and metering equipment was manifolded to serve either exchanger (See flow diagram Fig. 2).

Procedure—An inlet pressure was chosen to give the desired maximum rate of air flow (for most conditions an entering Reynolds number about 100,000) and the temperature corresponding to the desired percentage of moisture was determined. The rate of air flow and the pressure at the inlet to the exchanger were controlled by simultaneous adjustment of valves on the air supply and at the outlet of the exchanger.

After all conditions had been brought to pre-determined values, and had remained constant for a reasonable time, a "run" was started.

A "run" was in practically all cases of twenty minutes duration; all temperatures and pressures indicated in Fig. 2 were recorded at two min-

TABLE I—RESULTS

Run Number	% H_2O Entering	Re, Air Entering	V, ft./sec. in Annulus	Air Temperatures °F. Ent.	Air Temperatures °F. Exit	Air Temperatures °F. Av.	Water Temperatures °F. Exit	Water Temperatures °F. Ent.	Water Temperatures °F. Av.	$P_{av.}$, mm. of Hg	q, B.t.u./hr.	Δt_m °F.	Δt_{sv} °F.	Heat Transfer Coeff's., B.t.u./hr./sq.ft./°F. Over-all U	Gas film h	Over-all U'	Gas film h'	T_{si} °F.	h'_w B.t.u./hr./sq.ft./°F.
56671	10.0	15,390	3.32	119.9	54.6	80.0	47.9	48.2	48.0	871.3	7,900	27.07	32.0	13.78	15.7	11.67	13.0	52.5	370.5
55330	10.0	27,900	0.504	117.8	82.2	98.5	78.6	75.0	76.0	823.6	10,230	18.87	22.5	25.30	37.0	21.20	28.8	87.4	88.6
55334	10.0	27,700	1.465	117.9	98.0	106.0	95.2	94.9	94.7	820.7	6,710	10.06	11.3	31.0	43.1	27.6	36.8	100.4	108.4
56655	10.0	57,900	0.500	117.9	89.7	104.1	81.9	74.8	77.7	821.1	18,080	23.92	26.4	35.3	62.9	32.0	53.2	95.1	122.6
56669	10.0	58,600	3.320	119.9	101.1	110.0	95.4	94.9	94.9	868.8	13,430	13.33	15.1	47.0	75.8	41.5	62.5	104.3	144.7
56670	10.0	58,400	3.320	119.9	65.7	92.6	49.4	48.4	48.7	868.5	27,600	37.90	43.9	34.0	48.5	29.3	39.5	70.2	125.7
56666	10.0	96,300	3.29	119.9	72.1	97.3	49.5	47.5	48.3	861.1	42,300	43.55	49.0	45.3	75.7	40.3	62.6	78.0	161.3
56667	10.0	96,000	3.30	119.9	90.5	105.6	76.4	74.8	75.3	860.0	30,800	27.26	30.3	52.7	93.5	47.4	78.2	95.2	179.8
56653	10.0	98,800	1.50	119.9	104.5	112.3	96.5	94.7	95.2	859.2	18,730	15.63	17.1	55.9	112.6	51.1	94.6	107.5	197.3
54217	19.7	14,100	0.473	143.4	66.3	99.5	62.5	54.8	57.4	829.4	13,800	35.55	42.1	18.00	23.9	15.28	19.3	66.0	......
54225	20.0	22,950	0.496	144.0	71.7	105.5	64.3	54.4	57.8	826.4	22,250	40.8	47.4	25.44	38.4	21.74	30.5	74.7	22.0
54224	20.0	30,690	2.000	144.0	71.5	105.3	57.4	53.9	55.0	826.9	29,700	43.3	50.3	31.95	45.5	27.52	37.1	71.6	345.0
55306	20.0	95,000	1.496	144.0	100.1	124.5	64.7	54.2	58.7	817.2	63,350	61.1	65.8	48.35	90.8	44.9	79.5	111.3	123.4
54227	29.9	12,500	0.498	160.0	68.1	108.0	63.6	55.5	57.9	819.0	18,840	41.2	50.1	21.35	29.8	17.57	23.9	.....	......
54229	29.9	26,180	0.500	160.0	82.8	121.9	70.2	54.1	59.9	820.6	37,160	53.6	62.0	32.35	56.3	27.96	45.2	90.2	238
55335	30.2	32,900	0.506	160.4	106.8	136.0	91.3	74.9	81.6	819.0	40,950	48.15	54.4	39.7	76.6	35.1	61.2	119.1	133.3
55337	30.2	32,600	1.496	160.4	113.3	137.2	99.5	94.8	96.4	818.3	38,070	35.56	40.8	49.9	90.1	43.5	71.3	122.4	175.6
56685	30.0	33,800	3.32	162.4	77.3	121.5	49.4	47.1	47.8	863.1	56,700	62.7	73.7	42.2	66.9	35.9	52.3	69.8	......
55348	30.0	71,600	1.510	160.4	117.3	142.7	84.9	74.7	79.0	819.8	79,000	57.4	63.7	64.2	156.8	57.9	123.6	129.2	225.5
55349	29.9	71,800	1.510	160.3	129.3	146.9	103.4	95.1	98.7	819.1	65,400	44.6	48.2	68.5	173.7	63.3	143.9	137.4	261.0
55308	29.9	93,500	0.500	160.2	130.8	148.2	91.0	55.8	73.0	813.0	82,150	72.1	75.2	53.2	155.5	51.0	138.5	139.2	205.0
56683	30.0	105,500	3.39	162.4	135.9	151.2	100.0	95.1	97.3	851.0	85,700	50.8	53.9	78.8	209.5	74.2	180.3	143.0	285.7
56663	30.0	106,300	0.496	162.4	145.2	155.6	119.2	95.0	107.1	849.6	61,600	46.6	48.5	61.6	203.7	59.1	178.6	150.7	257.0
54236	45.2	15,310	0.494	178.2	79.1	128.8	69.9	54.6	59.6	825.3	34,740	56.3	69.2	28.8	46.5	23.44	33.9	77.5	......
54238	45.0	33,000	0.498	178.2	110.5	149.4	83.2	53.7	65.8	827.7	66,500	74.2	83.6	41.8	91.7	37.10	71.6	127.4	146.0
55302	44.9	51,060	1.492	178.2	116.1	152.0	69.0	53.8	60.0	828.1	99,650	83.7	92.0	55.6	119.0	50.6	98.2	131.1	175.7
55313	45.0	74,500	1.000	178.2	138.1	161.3	81.6	55.1	67.4	823.1	120,200	89.5	93.9	62.6	169.6	59.6	149	148.4	227.0
55321	45.0	89,800	1.001	178.2	145.2	164.4	84.1	55.8	69.3	821.8	125,800	91.7	95.1	64.0	181.2	61.7	164	154.7	225
55310	45.0	98,100	1.500	178.2	144.1	163.8	76.2	54.8	64.8	818.9	144,700	95.0	99.0	71.0	216.5	68.2	193	152.9	281
54246	60.0	19,210	0.498	192.3	97.1	151.4	78.7	54.0	62.7	844.9	56,400	72.8	88.7	36.2	68.2	29.75	49.3	114.8	147
55339	59.8	29,500	0.514	192.7	134.3	170.6	106.3	74.9	88.3	856.2	75,100	72.25	82.3	48.5	112.3	42.6	95.1	155.2	136.0
55341	59.8	30,000	1.492	192.7	133.0	168.0	105.5	94.9	98.9	856.8	77,800	59.3	69.1	61.2	133.4	52.5	98.2	150.6	185.0
56675	60.0	29,700	3.38	192.7	113.4	159.0	79.8	74.8	76.5	852.5	83,900	69.1	82.5	56.7	106.1	47.5	77.8	131.3	173.0
54248	60.0	45,340	1.496	192.3	127.8	167.3	71.7	53.6	60.9	845.0	120,300	95.7	106.4	58.7	132.7	52.0	104.2	147.4	170.0
56660	60.0	68,200	1.486	192.7	155.5	179.8	95.3	74.8	84.3	849.5	149,400	88.95	95.5	78.4	264.0	71.1	213.0	169.9	305.0
56662	60.0	67,200	0.504	192.7	175.4	186.7	134.5	94.9	115.3	848.2	99,300	68.8	71.4	67.4	258.5	64.9	225.0	182.3	287.0
54245	60.0	71,850	2.000	192.3	149.5	177.0	72.8	54.0	62.5	841.7	165,700	106.7	114.5	72.5	204.5	67.6	169.7	165.0	230.0
55312	60.0	110,900	1.507	192.3	175.5	184.6	82.6	55.2	68.6	833.2	184,500	112.5	116.0	76.3	246.0	74.0	230	178.6	274.0
55344	60.0	116,400	1.477	192.7	174.2	185.5	99.0	74.7	86.5	839.3	173,500	96.5	99.0	84.0	338.0	81.8	376	180.4	376.0
56681	60.0	99,900	3.32	192.7	175.5	186.4	105.1	95.1	99.9	838.9	166,600	84.0	86.5	92.6	331.0	89.9	302	181.8	362.4

ute intervals. In addition, the barometer was read, room temperature was recorded, and the weight of condensate during the interval was determined.

Calculation of Results—Analysis of results to secure film coefficients is necessary, since it is impractical to measure the temperature of the glass in an operating exchanger. In the choice of a basis for calculating coefficients, it appears reasonable to use the gas-side area of the tube (11.51 sq. ft. for the 1 in. and 21.44 sq. ft. for the 2 in.). The selection of a temperature drop is not so simple; for convenience of application to other conditions, the logarithmic mean of terminal temperature drops is distinctly advantageous, since this will normally be available. As pointed out by Colburn and Hougen, the temperature drop in dehumidification is likely to be greater throughout the rest of the exchanger than at the ends. For this reason, it is much sounder theoretically to use the difference of the average temperatures of the two streams. Our results are presented on both bases, with only those coefficients based on the true average included in the nomograph.

Heat balances across the exchangers checked within a few per cent, higher on the water side when cooling-water was below room temperature, and lower when above. Since heat quantities were all based on the air stream it was not considered necessary to insulate the jackets. The close check of heat balances verified our opinion of the completeness of saturation. The heat lost by the air stream was determined from the latent heat loss and sensible heat loss. The latent heat (at outlet temperature) for that amount of water which must have condensed between saturation at inlet and outlet temperatures was added to the sensible heat loss for the air and water vapor leaving the exchanger. These two heat quantities were computed on the basis of the amount of dry air measured at the orifice.

From the heat quantities, areas, and temperature drops so determined, overall coefficients of heat transfer were calculated. Since two different values of temperature drop were used, two sets of coefficients were possible; those based on the log mean are designated by U and h, while those based on the difference of the average temperatures are designated by U' and h'.

The work of Colburn and Hougen emphasizes the mass transfer, and expresses results in terms of water removed per unit area per unit time. Our experimental measurements of water removed have been compared with the values calculated from their equations, and found to be consistently 75 per cent of the computed values. The discrepancy is quite consistent except when the velocity of cooling water is very high, in which case the ratio is much smaller.

NOMENCLATURE

D = Diffusivity of water in air, sq.ft./hr.
N_A = lb. mols. ot gas diffusing/hr./sq.ft.
P = Pressure
R = Gas constant, ft.lb./lb.mol./°R.
T = Absolute temperature, ° R.
x = Film thickness, ft.
p_{b_i} = Partial pressure of air at interface
p_{b_g} = Partial pressure of air in body of gas
q = Total heat flux, B.t.u./hr.
h = Film coefficient of heat transfer derived from log mean $\triangle t$, B.t.u./hr./sq.ft./° F.
h' = Film coefficient of heat transfer derived ırom true $\triangle t$, B.t.u./hr./sq.ft./° F.
U = Overall coefficient of heat transfer derived from log mean $\triangle t$, B.t.u./hr./sq.ft./° F.
U' = Overall coefficient of heat transfer derived from true $\triangle t$, B.t.u./hr./sq.ft./° F.
Re = Reynolds Number, $\frac{d\,V\,\rho}{\mu}$
$\triangle t_m$ = Logarithmic mean of terminal temperature differences, ° F.
$\triangle t_{Av}$ = Average gas temperature — average water temperature, ° F.
Subscripts: A designates air inlet end of exchanger
E designates air outlet end of exchanger
G designates air stream
W designates condensate
Ann designates annulus

For application to design calculations, we feel that the coefficient of heat transfer is a more convenient expression of the behavior, and our work has emphasized the heat transfer coefficient. This has been done even though the correlation with coefficients calculated according to Colburn and Hougen has not been so satisfactory. For low percentage moisture, there is good correlation, but above 40 per cent H_2O entering, measured coefficients are much lower.

Since film coefficients could not be measured, it was necessary to break down the overall coefficients. Coefficients for the cooling water were calculated from the Dittus-Boelter[3] equation, using Nusselt's[8] equivalent diameter. The conductivity of the glass was corrected for temperature as recommended by R. W. B. Stevens.[6]

$$k = -0.00352_3 + 0.00245_4 \log_{10} T$$
cal./cm./sec./°K.

Bureau of Standards measurements[8] indicate that his values were consistently low, hence our conductivities are based on 0.668 B.t.u./hr./ft./°F. at 65°F.

The average temperature of the glass was taken as that at its center; this was determined by proportioning the overall temperature drop to that from the temperature of water to that at the mid point of the glass in the same ratio that the corresponding resistances were proportioned.

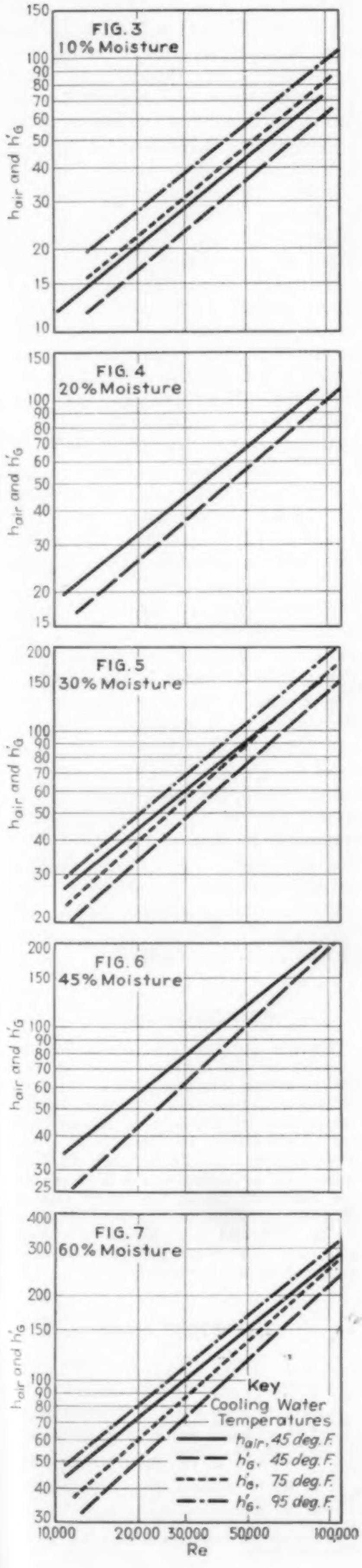
$$\frac{t_{glass\ center} - t_{H_2O}}{\triangle t} = \frac{R_{H_2O} + 1/2\, R_{glass}}{R_{overall}}$$

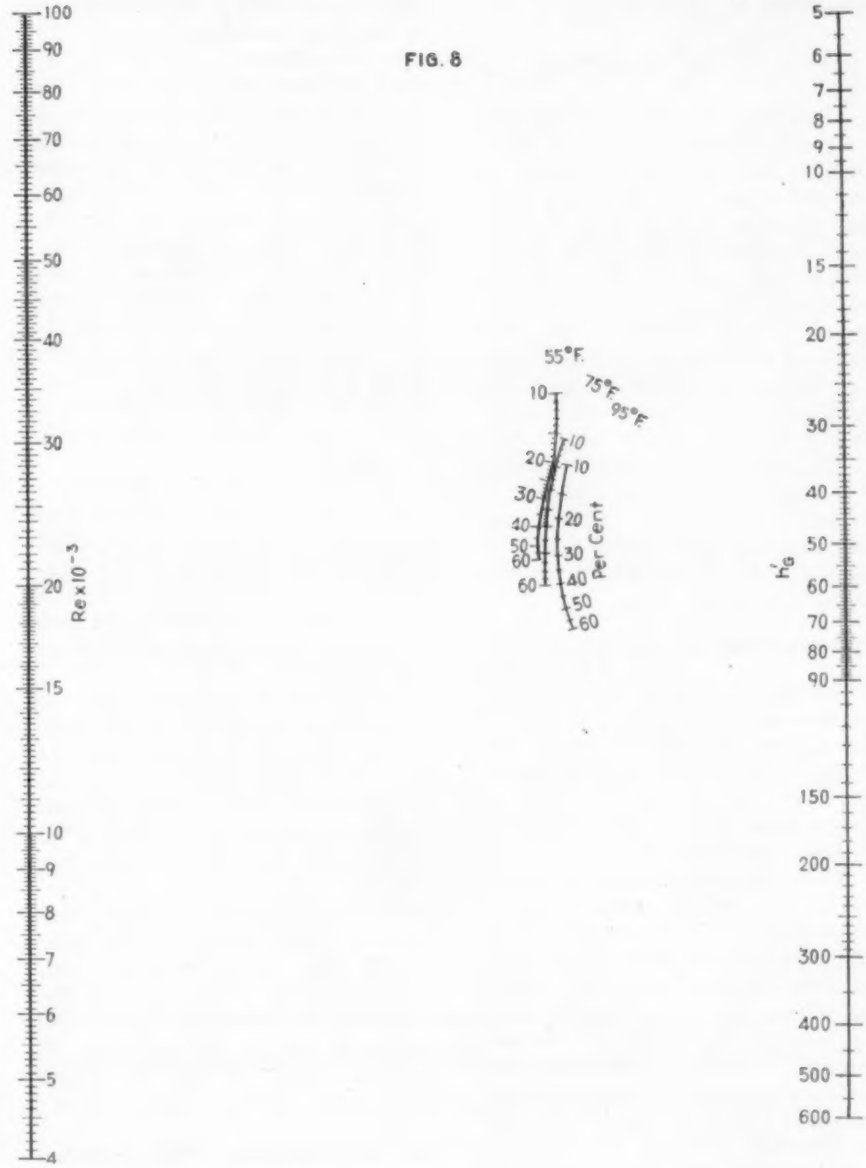
The resistance of half of the glass thickness (at the estimated temperature) was added to that calculated for the water film, and the fraction which this sum was of the total resistance was taken as the fraction of the total temperature drop between the average water temperature and the median glass temperature.

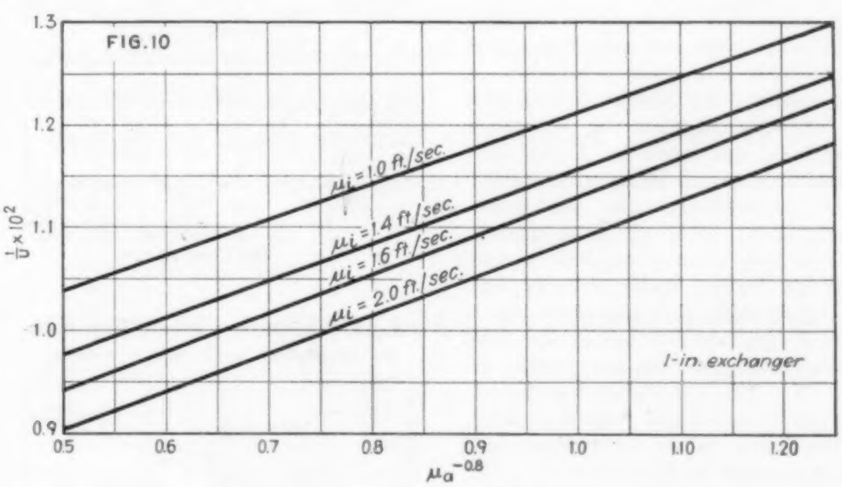
Resistance of the glass at this average temperature, and resistance of the water film are added together and the sum subtracted from the overall resistance, the remainder being the resistance of the condensing gas film. The corresponding film coefficients, h', are plotted in Figs. 3 to 7 and all are combined into the nomograph, Fig. 8 relating them to Reynolds number at entry, moisture percentage and cooling water temperature.

Gas film coefficients for the 1 in. exchanger are consistently higher than those for the 2 in.; no basis of correlation was found which would represent both satisfactorily. The use of entering velocity is obviously not the soundest method for relating coefficients to flow, but we feel that its utility in comparison with an average justifies such a basis. The Reynolds number is used with the realization that it may not be a true expression of the effect of rate of flow. This can be proven only by measurements on systems other than air-water.

These calculated gas film coefficients have been analyzed further to determine the distribution of resistance between condensate and gas phase. It is reasonable to assume that mass transfer obeys the fundamental laws of diffusion for a two







Figs. 3-7 — Graphs showing variation of air film coefficient with entering Reynolds number at various moisture contents for a 2-in. glass exchanger. Data summarized in nomograph, Fig. 8. Fig. 10—Variation of overall resistance with change in velocity. See table of nomenclature for definitions and units

component system in which only one component is diffusing:

$$N_A = \frac{DP}{TRx} \ln \frac{p_{bi}}{p_{bg}} \text{ mol./hr./sq.ft.}$$

All of these quantities are immediately available except the film thickness, x, and the partial pressure of the air at the interface, p_{bi}. The film thickness may be calculated according to Gilliland and Sherwood.[3]

Some heat will be transferred by convection in addition to that represented by mass transfer. The calculation of this quantity is easily handled through a convection coefficient calculated from the usual Dittus-Boelter equation, if the temperature of the gas-liquid interface is known. It is necessary to assume that the gas stream is of circular cross-section and that the thickness of the condensate layer is negligible compared to the area of the tube.

TEMPERATURE AT THE INTERFACE

The temperature at the gas-liquid interface is found by trial and error, the correct temperature being that at which the sum of the heat quantities calculated for the two mechanisms is equal to the measured amount of heat transferred.

When this temperature is known we have all of the data necessary for evaluating the importance of all of the component parts of the overall heat transfer coefficient, except the effect of the condensate layer. An empirical correlation of this condensate (residual) resistance with moisture percentage, cooling water rate, and total heat flux is presented as Fig. 9.

It is logical that the resistance of this condensate layer should be proportional to the amount of the heat flux. This is in turn a measure of the amount of condensate; and it is to be expected that the resistance would be decreased by higher gas velocities because of greater turbulence induced in the condensate. Logarithmic plots of these quantities in the form $h'_w.q/Re_A$ against average cooling water velocity had slopes of 0.25, and intercepts which varied with moisture percentage. The corresponding values are plotted as Fig. 9. The condensate coefficient, h'_w can be calculated from this chart.

Important values for typical runs are presented in Table I.

Non-boiling Coefficients — Difficulties in correlation of coefficients from wet air to water indicated the desirability of studying the behavior when both films were non-boiling liquids, also when the condensing film was practically pure steam. These measurements were made only on the 1-in. exchanger.

In the measurements of the coefficients from water to water, the same three-pass steam heater which was used for warming the condensing water was used for heating the water stream through the Pyrex tube. Water flowing through the annulus was taken directly from the city water supply. Observations covered a twenty-minute interval, during which time ten readings of temperatures and rates were taken. Coefficients were based on the inside area of the Pyrex tube, and a logarithmic mean temperature drop was used in the calculation.

For analysis to film coefficients and comparison of calculated and measured values, physical properties were evaluated at an average temperature determined as the arithmetic mean of the five observations on each stream, i.e., initial, final, and between each pass.

Correlation — Analysis of the water-water coefficients in the manner of Wilson[7] indicated that the film coefficients predicted by the Dittus-Boelter equation were accurate for the stream inside the Pyrex, but were low for the annular coefficients. The discrepancy could be rationalized by using a numerical constant of 0.032 instead of the usual 0.0225. Fig. 10 shows such a plot.

Extrapolation to zero annular film resistance of the plot of overall resistance against the reciprocal of velocity raised to the 0.8 power should give an intercept equal to the sum of the resistances of glass and inside film. Analysis of these intercepts for different velocities in the tube in the same manner verifies the applicability of the Dittus-Boelter equation to this coefficient. Extrapolation to zero film resistance now should enable calculation of the resistance of the glass alone. The resistance so calculated corresponds to a thermal conductivity for Pyrex about 25 per cent above the value listed in the literature. This discrepancy is substantiated by calculating overall coefficients for conditions corresponding to those measured. The coefficient so computed is in every case lower than that measured. This convinces us that either (1) we are over-conservative in our increase of the numerical term in the Dittus-Boelter equation or (2) that the thermal conductivity of Pyrex is better than the published values or (3) both. More exhaustive investigations of both of these factors are being carried out.

Condensation of Steam — Coefficients were measured in the 1 in. exchanger from steam inside the Pyrex tube to water in the annulus. The overall coefficients check quite closely with the results of Littleton and Bates.[4] Analysis indicates that even though considerable condensate accumulates, the resistance of the steam film is essentially negligible compared to that of the water film and the glass. Fig. 11 presents the overall coefficients for steam at two different entering pressures (900 and 1,300 mm.Hg absolute) as a function of cooling water velocity.

Fig. 9 — Condensate film coefficient measured in a Pyrex glass heat exchanger

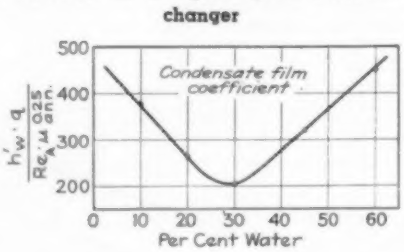
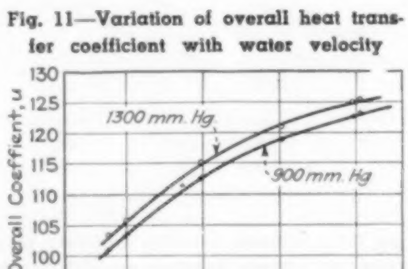


Fig. 11—Variation of overall heat transfer coefficient with water velocity



ACKNOWLEDGMENT

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CHEM. & MET. REPORT ON

Opportunities in the Petroleum Industry

FOR CHEMICAL ENGINEERS

Placing themselves in the position of young chemical engineers planning their life work, the editors of *Chem. & Met.* have sought out the facts about what the petroleum industry has to offer. They have inquired about its bigness, about its way of doing business and about its future. Furthermore, they have investigated the place of the chemical engineer—how he is hired, what he does, how much he is paid and what are his opportunities for advancement. Here are the answers as determined in many interviews and by much correspondence.

CHEMICAL & METALLURGICAL ENGINEERING

JUNE, 1940 Series C, No. 2

TITLE OF REPORT Opportunities in the Petroleum Industry

TO Chemical Engineers

FROM Chem & Met Editors

DATE May 1940

CONCLUSIONS

The petroleum industry is big. It is also progressive. It has large companies and small. There is little doubt that the future of the industry is as bright or brighter than that of any other in the United States today.

Because the industry is becoming more and more chemical in nature, it seems plausible to assume that more and more chemical brains will be required. The scale of operations dictates that many if not most of these chemically trained men will probably be engineers.

Chemical engineers are well paid in the industry. However, working conditions may leave something to be desired. Oil is by nature a dirty, greasy substance. Much of the work, at least in the early years, must necessarily require brawn as well as brain. Long hours may at times be demanded by the nature of the work or the keenness of competition.

But oil, like printer's ink, gets in one's veins, and those who like it wouldn't live without it.

Part I—The Petroleum Industry

Its Structure and Outlook

LARGEST AND MOST IMPORTANT of the chemical process industries, petroleum is of special interest to chemical engineers. Outside of the more strictly chemical industries, it has become the largest single employer of chemical engineering graduates. Its technology involves most of the unit operations and many of the unit processes. Its annual purchases of chemicals approaches \$100,000,000. No other major industry has changed and modernized its processes and equipment at such a rapid rate. And, most important of all, its future development seems certain to lie in the direction of further chemical progress.

Before considering its chemical engineering aspects and opportunities, let us review briefly the economic status of the petroleum industry.

Petroleum is a typically American industry—one of our largest and most important. It was founded on an American resource, developed by American methods and technology to a leading place among the industries of the world. The United States in 1938 produced 61.33 per cent of the world's crude oil and it consumed 59.46 per cent of all petroleum products. Per capita consumption in the United States is almost twice that of Canada, its nearest rival—more than four times that of the United Kingdom which was in the lead in Europe in 1938.

About \$15,000,000,000 are invested in American oilfields and refineries, in transportation, storage and marketing facilities. Refining alone is a \$3,500,000,000 business that produced \$2,500,000,000 worth of products in 1937, thus ranking fourth in all manufacturing enterprises of the United States. If we take \$5,000,000 as the average investment in an oil refinery, approximately \$2,500,000 are in equipment, \$2,000,000 in tank cars, transportation and storage facilities, and \$500,000 in offices, laboratories and shops.

More than a million workers earn

their living in the petroleum industry, which has an annual payroll of about $1,500,000,000. By far the largest proportion (70.9 per cent) of these workers (700,000) are in marketing. Drilling and production account for 150,000, refining 100,000. Pipelines and marine transport require another 50,000 employees. For the entire industry, the investment per worker is about $18,400; but this ratio is much larger in production, transportation and refining where it averages $43,500 as compared with only about $6,000 per worker in the field of marketing and distribution.

Purchases of products and services from other industries amount to approximately $800,000,000 per year. Recently as much as $200,000,000 has been spent annually on equipment, with an additional $50,000,000 for maintenance and supplies. Refinery purchases of chemicals, including tetraethyl lead, have been estimated at $100,000,000. American Petroleum Institute estimates that the annual research expenditure of the industry as a whole amounts to $22,000,000.

Of necessity, the petroleum industry is a mass-production enterprise that must produce large volumes of standardized products at low unit costs. Since vast amounts of capital are required for such operations, the industry is characterized by the size and integrated structure of its larger corporations. Joseph E. Pogue, eminent petroleum economist and vice president of Chase National Bank, has shown that in 1937 the 20 largest companies produced 56.2 per cent of the total U. S. production of crude oil—the largest factor accounting for 6.3 per cent of the total. For the same year, the 20 largest refineries processed 83.7 per cent of the oil run to stills—the largest company processing 12.3 per cent. The 20 most highly integrated companies produced 72.5 per cent of their own crude oil requirements.

Although these figures would seem to indicate the possible dominance of the industry by the larger corporations, it is true as Mr. Pogue points out, that there is still room for ample competition between larger and smaller units as groups, and among the various units as individuals. The same situation applies to research and technical development. As noted by the same author:

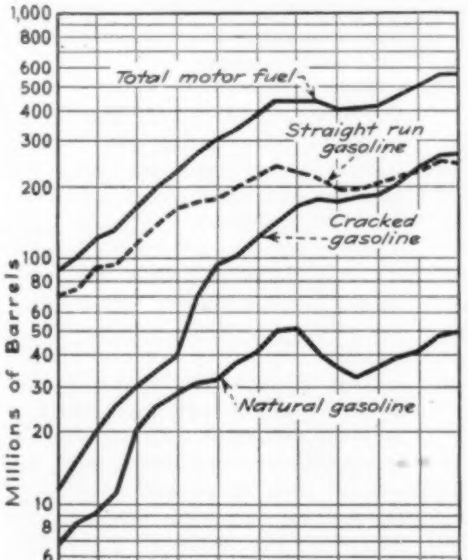
> An important resultant of the large amount of capital employed in the petroleum industry is found in the wide and growing application of technology to the reduction of costs, improvement in processes and betterment of products. In few industrial fields have applied science and engineering methods been so assiduously developed and utilized. . . . The technologic factor is a dominant element in every phase of the business. Without a dynamic technology, the industry could not have grown to its present size and importance.

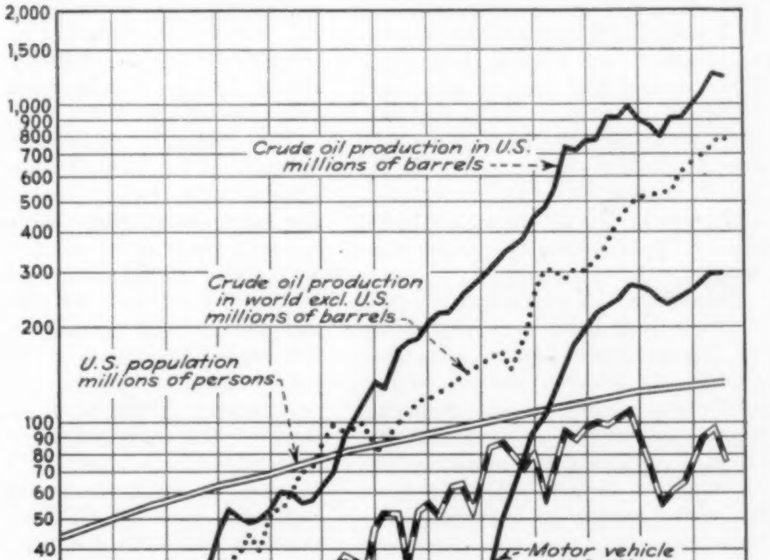
The petroleum industry has had a most interesting growth in the 81 years since Colonel Drake's first successful oil well was drilled in Titusville, Pa. In the past 30 years its growth curve has paralleled that of the automobile industry. (See accompanying charts.) From the standpoint of oil run to stills, May 1940 was the biggest month in the industry's history with 111,000,000 bbl., a phenomenal figure.

HOW THE INDUSTRY IS ORGANIZED

Petroleum industry has certain functional subdivisions which have come to be known as its major branches. Exploration and production come first. Transportation of crude oil comes next. Then comes refining followed by marketing and distribution. Management and administration are of course common to all divisions of the industry and so are the maintenance and service departments. Research and develop-

Left—Statistics for the production of motor fuels in the United States, 1918-1938, show rising importance of cracking
Right—Crude oil production in the United States and the rest of the world has grown at a higher rate than other indexes





From "Economics of the Petroleum Industry" by Joseph E. Pogue, March 1939

ment work was formerly confined largely to the refinery, but now scientific investigations have blanketed the entire industry—from geological and geophysical studies of crude-oil occurrence to exhaustive automotive researches on the utilization of motor fuels and lubricants.

Exploration — Exploration for crude oil is a new and rapidly developing field of technology, but perhaps of only incidental interest to chemists and chemical engineers. The geologist uses chemistry in his studies of rock formation and for core and soil-gas analyses. But the most brilliant scientific progress has been made by the physicist in studying and interpreting seismic phenomena and in developing and applying the torsion balance, the magnetometer and the seismograph. Largely through this work the probability of discovering oil has been greatly and consistently increased in recent years. Expressed by the Bureau of Mines in terms of oil discovered per dry hole drilled by the industry, this ratio has risen from 114,000 bbl. in 1916-20 to 309,000 bbl. in 1936-38. Likewise the size of the proven reserve of crude oil in the United States has risen to 17.3 billion barrels as of Jan. 1, 1939 as contrasted with only 12.2 billion bbl. for Jan. 1, 1935. The total proven reserve has an indicated life of 14.3 years based on the 1938 production rate. Another view of this situation was expressed by T. G. Delbridge in July 1937, in his presidential address to the American Society for Testing Materials, when he said that this country has "sufficient crude to supply the nation's needs for probably 150 years." The significance of this statement is that it expresses the technical man's confidence in the future of his technology—in replacing resources with research.

Production—Of more than 950,000 oil wells that have been drilled in the United States since 1859, approximately 360,000 are in active production. Some of the Pennsylvania wells brought in 50 years ago are still producing oil, thanks to an improved production technology that has added greatly to our petroleum resources.

The chemical engineer has aided the petroleum engineer in carrying forward many of these technical advances. Fuller knowledge of the characteristics of the oil-producing formations has led to the development of chemical treatment methods, such as the hydrochloric acid process that has released large volumes of oil previously unavailable. Fuller utilization of underground gas pressures has resulted from improved drilling technique and operating practices. Oil-well pressures as high as 2,000 lb. per sq.in. are controlled by the use of collodial muds that are manufactured *in situ* by chemical engineers and carefully controlled to meet most exacting specifications as to physical and chemical properties. Sometimes in drilling through certain formations so-called "heaving shales" are encountered and must be sealed off by chemical means.

Transportation—According to the 1939 edition of the American Petroleum Institute's "Petroleum Facts and Figures," the crude oil pipelines of the country have an aggregate length of 110,580 miles of which 57,820 miles were trunk lines and 52,760 miles were gathering lines in the various fields. In addition there were 4,458 miles of gasoline lines and 172,000 miles of natural gas lines. This great network of transportation facilities, which represents an investment of almost a billion dollars for petroleum alone, traverses 24 states.

Petroleum and its products make up one-third of all the water-borne trade of the United States. About a fifth of the crude oil run to stills in American refineries is received in oil tankers. Only a small fraction of the crude oil is carried by the railroads, but refined petroleum products are shipped largely in that way and the A.P.I. has estimated that one-eleventh of all the railroad freight revenue in the United States comes from the oil industry.

The principal chemical problems involved in petroleum transportation arise from corrosion, due largely to the corrosive character of the soils through which the pipelines are laid. Exhaustive studies have been made by the industry and by the government which have greatly increased our knowledge of this problem and the means of solving it.

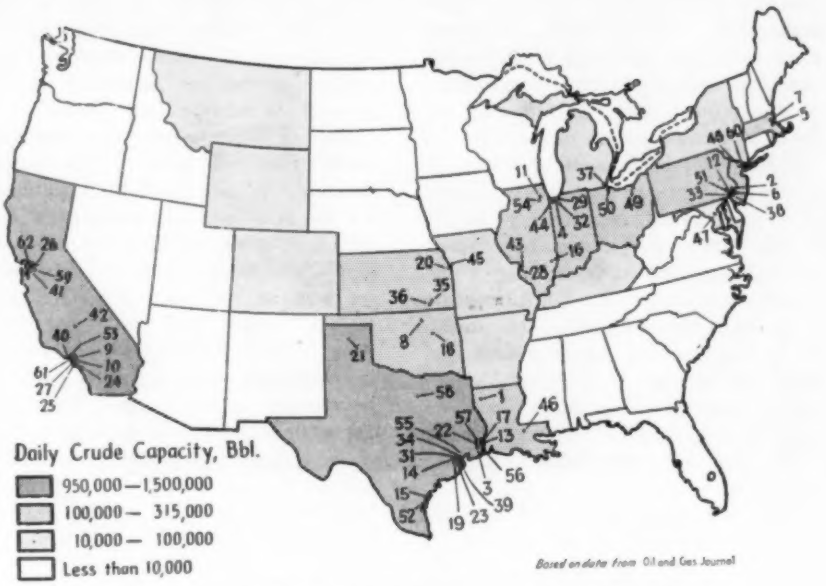
Refining—Twenty-five years ago most of the crude oil was distilled to produce only about 20 per cent of gasoline while the remaining 80 per cent was utilized for heavier products—kerosene, gas and fuel oils, tars, pitch and coke. The advent of the cracking process more than doubled the yield of motor fuels, from a barrel of oil, at the same time increasing its anti-knock qualities to make possible a 40 per cent increase in mileage per gallon.

Dr. Gustav Egloff has recently estimated that since 1913, when the first commercial cracking plant was built at Whiting, Ind., there has been a saving of over 13 billion bbl. of crude oil which otherwise would have been necessary to produce our gasoline requirements. Last year alone 1,400,000,000 bbl. of crude oil were conserved by the use of cracking units in the United States, for which he estimated an investment cost of \$450,000,000. Today a single topping and cracking unit equipped for polymerization of the cracked gases will handle more than 30,000 bbl. a day of East Texas crude oil to yield over 70 per cent of 70 octane gasoline. The cost of such a unit is nearly \$3,000,000. The early shell stills of 1913 operated at temperatures of about 750 deg. F. and pressures of 75 lb. per sq.in. as compared with 1,000 deg. F. and 1,000 lb. in modern thermal units.

Another measure of the advance of technology is seen in the steady improvement in the quality of motor fuels. Midgley's discovery of the remarkable anti-knock properties of tetraethyl lead marked the beginning of the race among refiners to raise the average octane values of gasoline. The *Oil and Gas Journal* reports that whereas the octane value of regular grade gasoline in 1931 was around 60, it had reached 65 by 1933, 68 by 1935, 70 by 1937, 72 by 1938 and 74 by 1939. Polymer gasolines of 80 to 90 octane values and special aviation fuels that far exceed the arbitrary 100 in the scale for iso-octane are now being produced in increasing amounts.

This progress has resulted from the combined efforts of many technologists, but a leading role has been taken by the chemical engineer. His knowledge of principles and methods for the application of heat and pressure and more recently of catalysis, has resulted in revolutionary advances in the design, construction and operation of all refining equipment.

As it became evident that thermally cracked gasoline was approaching a limit in anti-knock quality, the refining industry initiated several important lines of research. Polymerization processes were developed to utilize as raw material the hydrocarbons lighter than gasoline, combining them into larger molecules of higher anti-knock quality. More than 350 billion cu.ft. of such hydrocarbon gases which are now burned under stills or boilers are available annually for polymerization processes according to Dr. Egloff. As much as 300,000,000 bbl. of polymer



Petroleum Refineries in the United States With Capacities of More than 20,000 Barrels per Day, as of January 1, 1940

Key	Company	Refineries	Daily crude cap., bbl.	Other refineries, less than 20,000 bbl. capacity
1.	Arkansas Fuel Oil Co	Bossier City, La	23,000	
2.	Atlantic Ref. Co	Philadelphia, Pa	83,000	
3.	Atlantic Ref. Co	Atreco, Texas	22,600	
4.	Cities Service Oil Co. (Del.)	East Chicago, Ind	30,000	Ponca City, Ind.; Okmulgee, Okla.
5.	Cities Service Oil Co. (Pa.)	E. Braintree, Mass	25,000	Linden, N. J.; Titusville, Pa.
6.	Cities Service Oil Co. (Pa.)	Camden, N.J	22,000	
7.	Colonial Beacon Oil Co	Everett, Mass	30,600	
8.	Continental Oil Co	Ponca City, Okla	26,000	Baltimore, Md.; Wichita Falls, Tex.; Glenrock, Wyo.; Farmington, Artesia & Albuquerque, N. M.; Denver, Colo., Lewistown, Mont.
9.	General Pet. Corp. of Cal	Torrance, Cal	52,000	Lebec, Cal.
10.	General Pet. Corp. of Cal	Vernon, Cal	*28,000	
11.	Globe Oil & Ref. Co. (Ill.)	Lemont, Ill	20,000	
12.	Gulf Oil Corp	Philadelphia, Pa	30,000	Ft. Worth & Sweetland, Tex.; Staten Island, N.Y.; Pittsburgh, Pa.; Toledo & Cleves, Ohio.
13.	Gulf Oil Corp	Port Arthur, Texas	125,000	
14.	Humble Oil & Ref. Co	Baytown, Texas	140,000	San Antonio, Texas; Neches, Texas.
15.	Humble Oil & Ref. Co	Ingleside, Texas	25,000	
16.	Indian Ref. Co	Lawrenceville, Ill	23,000	
17.	Magnolia Pet. Co	Beaumont, Texas	100,000	Ft. Worth, Corsicana & Luling; Tex.
18.	Mid Continent Pet. Corp	West Tulsa, Okla	40,000	
19.	Pan American Ref. Corp	Texas City, Texas	79,000	Baltimore, Md.
20.	Phillips Pet. Co	Kansas City, Kan	23,000	Okmulgee, Okla.; Penwell, Texas.
21.	Phillips Pet. Co	Borger, Texas	35,000	
22.	Pure Oil Co	Netherland, Texas	59,000	Cabin Creek, W. Va.; Health & Toledo, Ohio; Muskogee, Okla.; Smiths Bluff, Tex.; Midland, Mich.; Marcus Hook, Pa.
23.	Republic Oil Ref. Co	Texas City, Texas	20,000	
24.	Richfield Oil Corp	Watson, Cal	80,000	Vinvale, Cal.
25.	Richfield Oil Corp	Hynes, Cal	*55,000	
26.	Shell Oil Co., Inc	Martinez, Cal	25,500	Oil Fields, Cal.
27.	Shell Oil Co., Inc	Wilmington, Cal	38,000	
28.	Shell Oil Co., Inc	Wood River, Ill	47,000	
29.	Shell Oil Co., Inc	East Chicago, Ind	30,000	
30.	Shell Oil Co., Inc	Norco, La	21,000	
31.	Shell Oil Co., Inc	Houston, Texas	74,000	
32.	Sinclair Ref. Co	East Chicago, Ind	45,000	K.C. & Coffeyville, Kan.; Wellsville, N.Y.; Sand Spgs, Okla.; Ft. Worth & Gladewater, Tex.; Parco, Wyo.
33.	Sinclair Ref. Co	Marcus Hook, Pa	45,000	
34.	Sinclair Ref. Co	Houston, Texas	60,000	
35.	Skelly Oil Co	Eldorado, Kan	23,000	
36.	Socony Vacuum Oil Co	Augusta, Kan	21,500	Buffalo, Olean & Brooklyn, N. Y.; Providence, R. I.; Casper, Wyo.; E. St. Louis, Ill.; E. Chi., Ind.
37.	Socony Vacuum Oil Co	Trenton, Mich	24,500	
38.	Socony Vacuum Oil Co	Paulsboro, N.J	25,200	
39.	Southport Pet. Co. of Del	Texas City, Texas	20,000	
40.	Standard Oil Co. of Cal	El Segundo, Cal	100,000	Bakersfield, Cal.
41.	Standard Oil Co. of Cal	Richmond, Cal	100,000	
42.	Standard Oil Co. of Cal	Seguro, Cal	25,000	
43.	Standard Oil Co. (Ind.)	Wood River, Ill	21,700	Neodesha, Kan.; Casper, Wyo.; Greybull, Mont.
44.	Standard Oil Co. (Ind.)	Whiting, Ind	119,000	
45.	Standard Oil Co. (Ind.)	Sugar Creek, Mo	21,800	
46.	Standard Oil Co. of La	Baton Rouge, La	100,000	
47.	Standard Oil Co. of N.J	Baltimore, Md	32,000	Charleston, S.C.
48.	Standard Oil Co. of N.J	New Jersey Works	104,500	
49.	Standard Oil Co. (Ohio)	Cleveland, Ohio	23,000	Latonia, Ky.; Toledo & Lima, O.
50.	Sun Oil Co	Toledo, Ohio	25,000	Yale, Okla.
51.	Sun Oil Co	Marcus Hook, Pa	82,000	
52.	Taylor Ref. Co	Corpus Christi, Tex.	20,000	Taylor, Texas.
53.	Texas Co. (Calif.)	Los Angles, Cal	37,000	Fillmore, Cal.
54.	Texas Co. (Del.)	Lockport, Ill	36,000	Shreveport, La.; Sunburst, Mont.; San Antonio, El Paso & Amarillo, Tex.; Norfolk, Va.; Claymont, Del.; Providence, R.I.; West Tulsa, Okla.; Pryse, Ky.; Casper, Cody & Calpet, Wyo.; Craig, Colo.
55.	Texas Co. (Del.)	Houston, Texas	25,000	
56.	Texas Co. (Del.)	Port Arthur, Texas	135,000	
57.	Texas Co. (Del.)	Port Neches, Texas	36,000	
58.	Texas Co. (Del.)	West Dallas, Texas	20,000	
59.	Tide Water Assoc. Oil Co	Associated, Cal	42,000	Watson, Cal.; Avon, Cal.; Drumright, Okla.
60.	Tide Water Assoc. Oil Co	Bayonne, N.J	55,000	
61.	Union Oil Co. of Cal	Wilmington, Cal	57,000	Maltha, Cal.; Santa Paula, Cal.; Avila, Cal
62.	Union Oil Co. of Cal	Oleum, Cal	34,000	

* Shut down.

gasoline might ultimately be made from such sources.

Catalytic cracking processes have been evolved which may in time supersede the established thermal units. Nearly $50,000,000 has been spent for Houdry units alone which are reputed to have a cracking capacity in excess of 150,000 bbl. per day —enough to make more than 5 per cent of the nation's gasoline requirement. Catalysis seems to offer the advantage of lower-cost equipment, combined with improved quality of product and greater flexibility in the choice of raw material. Dr. Egloff reports that catalytic cracked gasoline of 80 octane has been produced with yields of 85 per cent on a recycle basis.

A third and most interesting trend is toward the use of the unit processes of organic synthesis in the manufacture of synthetic fuels and blending agents of exceedingly high anti-knock properties. Alkylation units now in operation or under construction are expected to yield 4,000,000 bbl. per year of highest quality aviation gasoline. Several sulphuric acid alkylation plants have been built in the past year. Thermal alkylation has attained commercial significance only in the last six months. These developments are particularly important from the standpoint of national preparedness.

At least one large isomerization plant has been built to make isobutane from butane. (It can also make isopentane, an important gasoline ingredient, from pentane.) Isobutane is important as a raw material for both thermal and catalytic alkylation processes. Catalytic dehydrogenation is now carried out on plant scale. It is possible not only to convert butane to butylene but to make benzene from cyclohexane.

Benzene and toluene can be made in one step by aromatization. These aromatics are known to raise the anti-knock characteristics of motor fuels but opinion is divided as to the desirability of doing so on a large scale. Nevertheless, this aromatization process is important from another standpoint. It can be used in the production of chemicals from petroleum. In the past few years there has sprung up a new chemical industry based on petroleum as the raw material. The major oil companies have been taking advantage of this new market by setting up new plants and forming new subsidiaries to manufacture organic chemicals—a phase of oil refining that is merely in its infancy.

Still other products of petroleum have felt the chemical engineer's activities. Lubricating oils have been studied and improved through the application of solvent extraction,* propane dewaxing and other chemical engineering processes. Natural gasoline recovery has been made a much more efficient source of large volumes of high-quality products. Chemical treatment processes have been put on a continuous basis.

The use of new and better materials of construction has greatly reduced corrosion losses and equipment failure due to high temperatures and pressures. Sulphur removal, once the bane of the refinery, has not only been perfected, but methods developed for sulphur recovery and utilization. Sludge-acid processes have taken on the high efficiency of chemical manufacturing operations.

Marketing and Distribution — Twelve years ago in an article in the January, 1928, issue of *Chem. & Met.*, the late Dr. Arthur D. Little said: "Chemical engineering begins in the oilfield and it does not end at the refinery for at least one of the larger companies is recruiting its sales force from chemical engineers. It is also coming to be recognized that the selling of high grade refinery and other equipment has become a job for the engineer rather than one for the (non-technical) salesmen."

The marketing system of the petroleum industry is, of course, a tremendous field of activity because no other business with the possible exceptions of food, clothing and shelter touches so intimately on the lives of so many of our people.

Service Departments—Cutting horizontally across all of the major divisions of the petroleum industry are the functions of management and administration, engineering, research and development, technical and sales services, as well as purchasing, personnel, safety and industrial relations. In all of these activities there is a growing opportunity for the technically trained man. The number of chemical engineers who have risen to important executive responsibilities in the industry is especially noteworthy—perhaps second only to the strictly chemical industry.

* A modern nitrobenzene unit of Atlantic Ref. Co. is shown on cover of this issue.

Part II—The Chemical Engineer

In Petroleum Refining

SINCE PETROLEUM REFINING involves almost all of the fundamental unit operations of chemical processing, it is quite logical that the chemical engineer should hold an important place in the industry.

Furthermore, there is a decided trend in the direction of increased technical employment. In 1920, according to a WPA, National Research Project report, there were only 145 research workers in the petroleum refining industry. Only five companies maintained research laboratories. But in 1931, 47 companies maintained laboratories and employed nearly 3,000 research workers. In 1938 the figures had risen to 53 companies and more than 5,000 workers. On the basis of reports from 37 of those companies Perazich has estimated that 40 per cent of the workers were chemists; about 25 per cent were engineers. Assuming 20 out of the combined 65 per cent were chemical engineers by education or by function and adding an equal number for chemical engineers in operating and in engineering departments plus a miscellaneous group in equipment companies and non-technical departments, it seems reasonable to estimate that there are more than 2,500 chemical engineers in the petroleum industry or engaged in designing equipment for the petroleum industry. Many oil men would say that this figure is low especially in view of the fact that approximately one-eighth (See *Chem. & Met.* for Dec. 1931, p. 693) of the 2,000 annual chemical engineering graduates are going from the colleges into the petroleum industry.

How They Are Hired—In most cases these new chemical engineers are hired directly from the colleges—either by a company interviewer or following written application to the company by the graduate. Hiring is almost never done by correspondence alone. One or several interviews are usually necessary. In many companies the personnel department cooperates with the technical department in this way: A personnel representative calls at the college, interviews several men and selects one or two as promising candidates. These are sent to company headquarters—all expenses paid—for further consideration. There they are interviewed by the technical director, the personnel director and the head of the department in which the successful candidate will start. One technical director stated that 75 per cent of his men were hired this way.

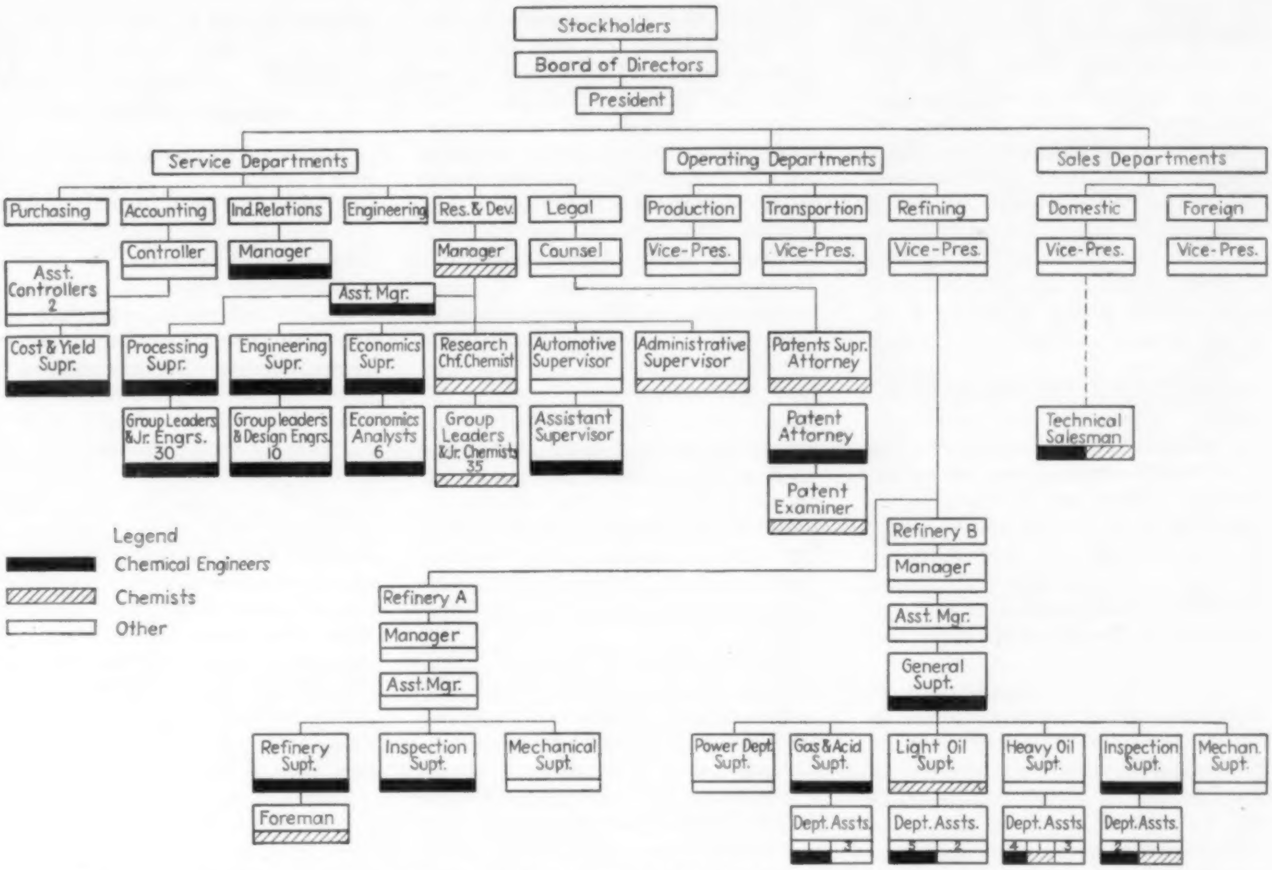
Very few men are hired from agencies. An appreciable number, however, makes contacts at conventions or scientific society meetings where an employment service is maintained, e.g., at meetings of the American Chemical Society. Then there are several men hired through personal contacts with the company—friends or relatives of other employees generally. A small number may receive jobs by merely writing in to the company for an interview. Unless these letters are unusual or are given special consideration by reason of a recommendation, they may not be very effective.

A hiring scheme which some of the more progressive refining companies have found highly satisfactory is as follows: Several candidates are selected at the end of their third year in college. They are hired for summer work at the refinery, replacing men on vacation. At the end of the summer the employer can judge more easily and accurately the relative value of the men for permanent jobs after graduation. And the employee can decide whether he really wants to work in a refinery after all.

The First Job—Once the chemical engineer is hired, the next question is: "Where does he go to work?" More chemical engineers start in the research and development department than elsewhere in the company. However, the work here may not be the type the student or layman might visualize as "research." Oftentimes the first job is shift-work in the operation of one of the department's pilot plants.

These pilot plants, like the refinery, must run 24 hours a day; so the research man must be on the job for his 8-hr. stretch whether it comes from 8 to 4, 4 to 12, or 12 to 8. It isn't a white-collar job. It is often a dirty, greasy job—operating valves, taking readings, checking details on a semi-works size refining unit.

That is one type of starting job. Another technical director might set his neophytes to analyzing oil samples. This type of work is simulated in the oil-testing laboratories in the colleges. Here the newcomer



Chemical engineers fill many varied positions in the organization chart of a modern integrated oil refining company

learns the properties of petroleum fractions and the methods for their determination.

Still a third chemical engineer might start to work in laboratory process research. That would consist of running samples through a very small refining unit with a view to developing new processes, new products or evaluating process variables. Chemists rather than chemical engineers are often called upon to do this type of research.

All of the above-mentioned cases apply only when the man starts in the research and development department. When a chemical engineer starts in the refining department, he may be faced with an entirely different set of conditions. There was the case of one young man who began as a fireman. It was his job to keep a fire going in a tube furnace. He had to regulate the fuel oil supply, check on the performance of pumps, the temperature in the furnace, the temperature of the charging stock, etc. Above him on the same unit were the operator and his helper—neither of them college trained men. After three months of firing during the summer vacation period, our young engineer was transferred to the chemical treating plant where he operated the equipment and made observations for a month. His next job was making routine tests in the control laboratory for a month, often going out into the yard to take his own samples. After lab. work came a month of freelancing where his instructions were merely to observe operations in the refinery, learning what he could. (It might be well to point out that a person may often learn more by observing than by doing. He would probably perform a given operation one way every time, while if he watched four other persons do it, he would see it done four different ways. Then he could choose the best way.)

A month's clerical work in the office doing filing, transcribing, etc., served to round out the young man's experience and he was assigned to an engineering problem. Upon its successful completion, he became a plant engineer to be called upon for solving technical problems. He was also free to initiate process modifications for improvement.

Lines of Promotion—Going back to the men who started in research—what was their progress? After a training period of similar nature and six to eighteen months duration, these men have several paths open to them. They may continue in the department and become process engineers called upon to solve specific problems from time to time. (This work may often involve process equipment design and plant layout.) Or they may be transferred to either a technical or non-technical department. Some go into responsible positions in the refinery— usually assistant supervisors in some department, e.g., cracking. Others may go into sales, public relations, personnel, purchasing, patents, or other departments of the company where the individual's personality and technical training are best suited.

It is in this way that chemical engineers have spread to the far corners of the petroleum industry. Progressive companies recognize the fact that chemical engineering training, because of its stress on fundamentals, serves a man well no matter in what part of a chemical enterprise he finds himself. As an example of this tendency, note the manner in which chemical engineers are spread through one integrated company (see organization chart above which resembles that of Atlantic Refining Co.).

Another interesting example is that of 16 chemical engineers that came out of the Research Laboratory

of Applied Chemistry at M.I.T. in 1927 to undertake the research work in hydrogenation at Baton Rouge, La. Of the 16, 13 are still connected with some one of the Standard Oil Co. of N. J. affiliates, 2 have taken responsible positions in other companies and 1 is deceased. Of the 13 Standard Oil men 8 are with Standard Oil Development Co., 2 with Standard Oil Co. of N. J., 2 with Standard Oil Co. of La., and 1 is assistant general manager of the Standard Vacuum Oil Co. in Sumatra. All these men are in responsible positions. Three are vice presidents, two are London representatives, one is a patent attorney, one is an accountant, four are in responsible charge of research and process work, and one is a sales manager. Certainly the story of this group illustrates the broader participation of chemical engineers in the affairs of the process industries.

The process by which chemical engineers grow into purchasing agents or sales engineers may be planned or may be spontaneous. In some companies a very definite training program is followed along the lines suggested above. In other companies the young engineer is shifted around only as openings appear in various departments. Some companies have job classifications, specifying the type of work required of each man, the scope of his authority and the maximum and minimum salary allowable for the job. In other plants the job classifications may be antiquated and make no allowance for technical men. In the latter case a chemical engineer may have to be listed on the company payroll as a fireman, pumper, assistant machinist or some other subterfuge title which allows him to receive the proper compensation.

Salaries—In the matter of salaries the petroleum industry treats its chemical engineers well. For men with bachelor's degrees, Eastern refiners pay starting salaries of $125 to $160 per month. Those figures take in both extremes. The determining factors may be age, previous experience or competition for services. Probably the two most popular starting salaries are $135 and $150. At least one company utilizes the latter figure as a flat rate.

Men with master's degrees are compensated at a higher rate varying from $160 to $180 per month to start. Ph.D.'s receive a starting salary of $175 to $250 with the average at about $225.

Policies regarding raises are not uniform. Some companies review the salary status of each employee once a year and make adjustments where they seem to be merited. Other companies make general salary raises periodically (though few companies have followed this policy in recent years). Still others give one or two automatic raises in the first year and employ a merit system thereafter. Fundamentally the aim of most managements is to encourage their employees by a regular annual raise (providing employees are progressing) until they have reached 10 years' service. Thereafter salary increases are more often dictated by the value of the service a man performs, his ability to do the job well and the presence or absence of another market for his services. For salaries during that first 10-year period, one technical director offered this formula:

Annual Salary = \$1,500 + 200 y where y = number of years of service.

This formula is, of course, applicable only to graduates with bachelor's degrees.

Equipment Design—An important field for chemical engineers that has not hitherto been mentioned is found in the equipment companies that serve the petroleum industry. Many of these companies conduct research, not often of a fundamental nature, but usually development in pilot plant work. For this they require chemical engineers. These companies also employ large numbers of chemical engineers for process equipment design. This is an advanced application of the type of work carried on in the colleges in courses on chemical engineering design. It differs mainly because of the ever-present dollar sign. Equipment companies tend to favor men with master's degrees over first degree graduates. Chemical engineers are paid well for this work, usually better than in the petroleum industry itself. However, many men have started out as designers and then gone into the refineries to become plant engineers and supervisors.

Of course, there are in our refineries today many men fulfilling a chemical engineering function who are not chemical engineers at all. They may be mechanical engineers, chemists or other types of professional men, or they may have come up through the ranks with no college education at all. These men have learned their chemical engineering the hard way—through experience in the plant; yet most of them who are in responsible positions realize the value of the technical education they did not get and are making every effort to fill their ranks with Ch.E. graduates.

WORKING CONDITIONS

Important considerations to the new employee are the conditions under which he is expected to render his services. Employer-employee relations, hours of work and overtime compensation fall in this category.

The petroleum industry has long been a leader in fostering sound employee policies. Because most of the companies are large, they have found it necessary and desirable to go to extremes to insure against labor difficulties. Vacations with pay are now standard practice for all salaried men with more than one year of service. Likewise vacations with pay are accorded wage earners after a longer period of service (usually at least three years before a two-week vacation is granted). In most cases a two-week vacation is the standard. However, many companies are lengthening this period to three weeks for men with 15 or 20 years of service.

Hours of work are usually low in the industry. For technical men they vary from 35 to 44 hours per week. However, the job classification has an important bearing on this subject. In most cases where chemical engineers work in the refinery on an hourly basis, the number of hours is fixed and they are compensated for overtime at an increased rate (usually time and a half). But where the chemical engineer works on a salary (the usual case) his hours are often determined by the character of his work and at times he may find it necessary to work many extra hours without compensation.

In the case of the professional man there are certain requirements and privileges not accorded other employees. First, he is expected to improve himself outside of working hours. This means extensive reading and perhaps graduate work at night school to keep abreast of developments in his field. Second, he may be privileged to attend meetings of technical societies and broaden his knowledge by travel at company expense. Policy on these matters varies widely from company to company, but the petroleum industry as a whole is known for its progressive ideas along these lines.

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Machinery, Materials and Products

Chem & Met Process Equipment NEWS

White Print Machine

MODEL A is the designation of a new automatic, high-speed white print machine that has been announced by the Ozalid Corp., 354 Fourth Ave., New York, N. Y. It is stated that the new machine produces Ozalid positive type prints at speeds ranging up to 20 linear ft. per minute. An important feature is the automatic separation of the original and the print. The operator stands in front of the machine, merely feeding in the original and the sensitized material, whereupon the machine completes the exposure, separates the original and print and returns the original to the operator while the print is carried through the developer and discharged at the rear of the machine, dry and ready to use. Either cut sheets or continuous yardage can be handled automatically. Any light intensity between full illumination and 60 per cent of this intensity may be selected to permit uniform printing.

Link Leather Belt

GREAT FLEXIBILITY is claimed for the new Duplex link leather belt recently announced by Alexander Bros., 406 North 3d St., Philadelphia, Pa. The new belt is composed of double ply links of leather formed by bonding together the flesh or rough sides of two single links, producing one solid link with the grain side of the leather on the outside. These links are bored and then joined together with steel connecting pins, the ends of which are counter-sunk in the end links to avoid damage in running against the end of the pulley. Friction between links is said to be minimized resulting in longer belt life and a higher percentage of transmitted power. The belt is designed for slow, heavy-pull drives where some slippage is required and is particularly recommended by the manufacturer for paper mill winders and similar drives.

Kneading Machinery

SAID TO REPRESENT entirely new design principles throughout, with no mechanical resemblance whatsoever to earlier constructions, a new line of mixing and kneading machinery has been introduced by the Patterson Foundry & Machine Co., East Liverpool, Ohio. Made under the name of Kneadermaster, these new mixers are available in any desired batch capacity from the ½-gal. experimental unit up to a size of 1,500 gal. Sixty different combinations of frames, sizes, and horsepowers are built in a variety of types and strengths for widest possible utility on medium- and heavy-duty operations. The equipment is recommended by the manufacturer particularly for the mixing and treating of heavy plastics and tenacious materials of every description.

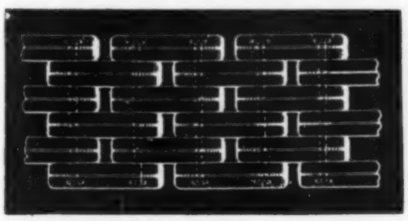
Area Type Meter

ADAPTED PARTICULARLY to the measurement of liquids which are viscous or corrosive, a new type of flowmeter known as the Linameter has been developed by the Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia, Pa. The body of the new meter is installed as an integral part of the pipe-line. It contains a weighted disk positioned by the velocity of the fluid through a tapered throat section, in such a manner that the disk travel is directly proportional to the flow rate. Attached to the disk is a rod and iron core, the latter traversing the field of two reactance coils surrounding the pressure-tight tube of the meter body. These coils form a reactance bridge which, connected electrically to similar coils in the indicating, recording and integrating instrument, forms a means of transmitting the measurement to any desired distance from the meter body. The recording instrument employs the galvanometer null principle. A uniformly graduated scale is used. Advantages include high accuracy over a wide range, easy change of capacity and a simple and reliable integrator, according to the manufacturer.

New Products

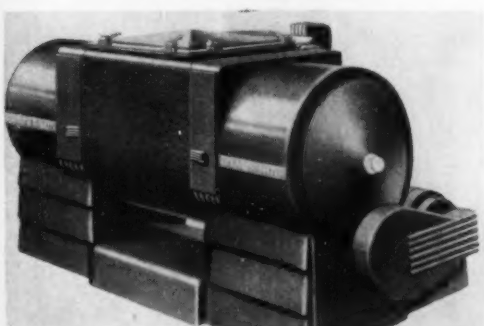
A NEW corrosion-resistant paint containing electrolytically refined metallic copper, in a suitable vehicle, has been announced by the Phelps-Dodge Refining Corp., 40 Wall St., New York, N. Y. The pigment is composed of extremely thin copper flakes which are stated to lie parallel with the paint film and thus afford greatest protection to the largest possible surface. Four types are available, three for industrial and general purposes and one for marine use. The general utility type is used both for priming and for the finish coating of steel or wood. A special purpose type is used on

Section of link leather belt

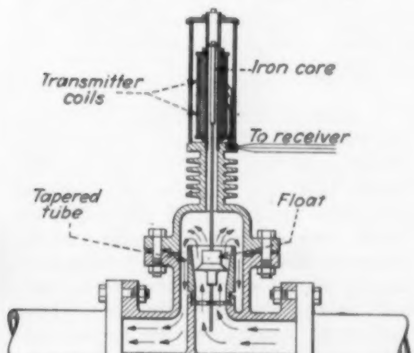


High-speed white print machine

Patterson Kneadermaster mixer



Cross section of new Linameter



wood, metal, cement or concrete floors and is particularly recommended for resistance to abrasion and petroleum products. A satin luster type is produced for use on wood or metal.

A JOINT SEAL which is said to be completely resistant to propane, pentane, benzol, petroleum products of all types and other materials has been introduced by the Glyco Products Co., 148 Lafayette St., New York, N. Y., under the name of Glycoseal. The material is stated to be flexible, leakproof and non-cracking. It may be used on rubber and all kinds of metal fittings and is claimed not to harden in the joints.

DEVELOPMENT of a paraffine wax emulsifier for use in all processes and products where such wax is needed has been announced by the Technical Service Department of National Oil Products Co., Harrison, N. J. The new emulsifier, known as Nopco 2251, is a heavy, tan-colored paste which is mixed with paraffine to make the wax water dispersible. It is claimed that the new material is capable of producing a stabilized emulsion spontaneously without rapid agitation and without special equipment.

INTENDED for producing non-slip surfaces on concrete, wood and other floors, a new rubber-base paint containing an abrasive has been introduced under the name of Safe-T-Step by the Truscon Laboratories, Box 69, Milwaukee Junction Post Office, Detroit, Mich. The new material is said to be highly resistant to wear and decidedly non-slippery even when wetted or oil splashed. Perfect bonding to old paint, provided the latter is in sound condition, is claimed.

THROUGH a new development in plastic materials, the Irvington Varnish & Insulator Co., 24 Argyle Terrace, Irvington, N. J., has been able to announce a line of extruded tubing manufactured in continuous lengths for use particularly in electrical insulation. The tubing is said to be flexible, of high mechanical strength and resistant to heat, moisture, oils and other agents. It is claimed to be low in cost, yet to have high tear and abrasion resistance and to be more fireproof than other materials of similar type.

A RECENT ANNOUNCEMENT of Resinous Products & Chemical Co., 222 West Washington Square, Philadelphia, Pa., states that this concern has acquired the rights to the United States patents of the Department of Science and Industrial Research, London, England, on the use of synthetic resins as acid and base exchange compounds. Both cation or base exchange resins, and acid exchange resins, have been developed. If the removal of only the metal ion is required, the cation type resin is used. Similarly, the acid exchange resin can be used alone for the removal of acid ions. In general, however, both types are used in combination so that the hardness and solids content of treated water can be markedly reduced, approaching, at least as a theoretical limit, the purity of distilled water. Such resins at present are in use in Europe.

Straight-Line Exhauster

DEVELOPED as a companion to its elbow-type exhauster, the L. J. Wing Mfg. Co., 154 West 14th St., New York, N. Y., has announced a new straight-line exhauster designed particularly for handling air containing steam, dirt, fumes, vapors and other materials which should be kept from contact with the motor. The new exhauster is built in both horizontal and vertical types with a belt drive permitting the selection of any fan speed to suit the condition of air volume and resistance. The Wing-Scruplex propeller fan is used, with the motor located outside the duct and a streamline casing provided for the belt and fan pulley.

Ring-Balance Meter

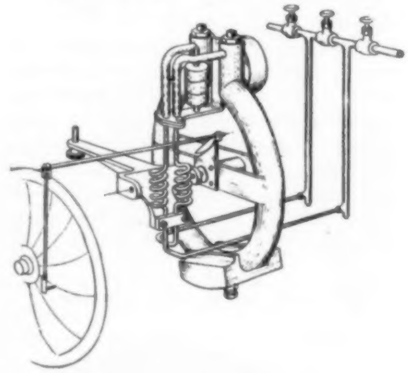
METERING of steam, liquids and gases at static pressures up to 1,000 lb. per sq.in. is accomplished with a new mechanical meter of the ring-balance type which has been announced by Republic Flow Meters Co., 2240 Diversey Parkway, Chicago, Ill. The new meter will give full-scale readings on differentials as low as 3 in. of water, and is also available for various higher differentials. Three types are built to provide for the various ranges. The meter consists of a hollow steel ring centered on a special ball bearing to tilt freely about its horizontal axis. The ring is partitioned at the top to form a U-tube, the bottom section of which is filled with a sealing liquid such as oil or mercury. The chambers above the fluid are connected by flexible tubing to pipe connections leading to the orifice or flow nozzle. Tilting of the ring under differential pressure is communicated through a cam to the pen-shaft and pen, the cam compensating for the normal square-root relation and giving an evenly divided chart scale. An intermittent type integrator which adds up four instantaneous values per minute is employed.

Horizontal Mixer

AN IMPROVED horizontal drum-type mixer operating on the cut-divide-remix principle and rated at 1-ton capacity has been announced by the Prater Pulverizer Co., 1801 South 55th Ave., Chicago, Ill. This mixer employs a new combination of mixing and lifting blades and dual spirals running in opposite directions within the drum. Operating at $4\frac{1}{2}$ r.p.m. the course of the material is interrupted and changed 26 times per minute. The mixing and lifting baffles are offset, so that they alternately collect their loads from opposite ends of the drum and feed them evenly back to the dual spirals. Spirals revolving in opposite directions again divide the load and each spiral carries its portion to the opposite end of the drum. Heavy gage welded steel is used throughout. Slow speed shafts are carried in bronze bearings and other shafts in self-aligning, dust-tight ball bearings. Special double seals under spring tension are provided at both ends of the drum.

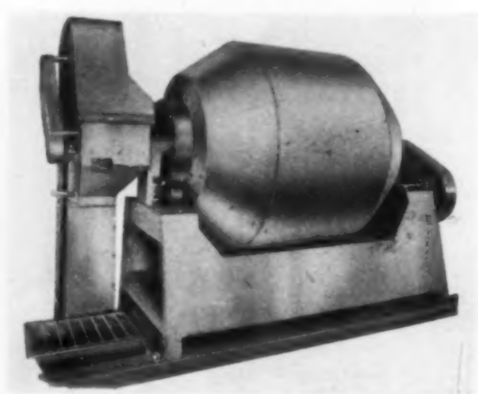
Another recent development of this company is a special grinder for the

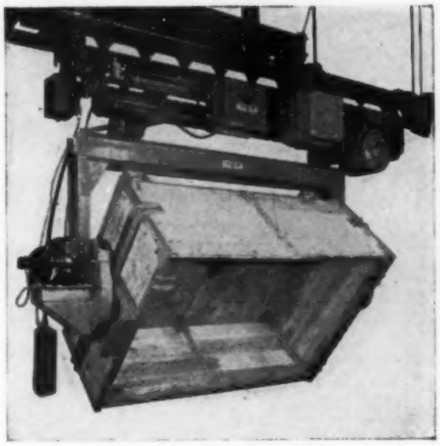
Diagram of ring-balance meter



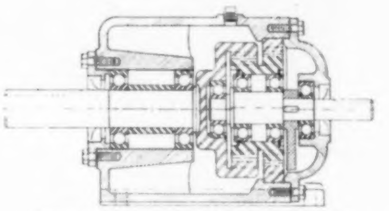
New straight-line exhauster

New horizontal mixer





Box grab and tramrail carrier



Cross-section of new speed reducer

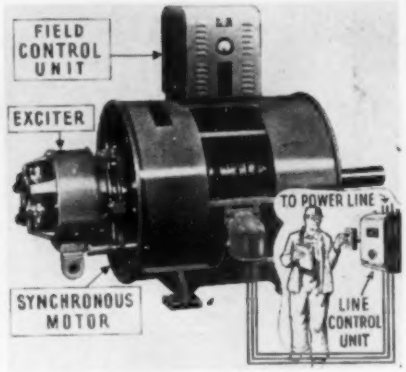
reduction of dry, light and fibrous materials. The company claims twice the capacity per unit of power consumption for the new machine as compared with earlier types of grinder. The mill is of a new impact type designed for easy removal and changing of the screen without disturbing the feeder. A strong flow of air through the grinding chamber limits waste recirculation of ground material and reduces heating of the material being ground.

Box Tramrail Carrier

A BOX which may be turned to any position by means of a gear-motor drive is a feature of a new full-rotation box grab and tramrail carrier recently announced by Cleveland Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. A twin hoisting unit enables the box to be raised or lowered as desired. The box is securely clamped in position by means of a handwheel located at one end, with the gear-motor rotating mechanism at the other end. The hoisting speed of 20 ft. per min. and the travel speed of 150 ft. per min. are controlled by a push-button station which also controls the rotation. Various sizes up to 5 tons (including box, grab and material) are available.

Speed Reducer

COMPACT DESIGN and high ratios of speed reduction without the use of large gears are features of a new speed reducer recently put into production by the Brad Foote Gear Works, 1301 South Cicero Ave., Cicero, Ill. A double spur or combination spur and



"Packaged" synchronous motor

internal gear mounted on ball bearings on an eccentric section of the drive shaft meshes with a stationary internal gear. In mesh with the second eccentric-mounted gear, is either a spur or an internal gear attached to and concentric with the output shaft. The eccentric drives the initial spur around the pitch line of the stationary internal gear. Since the initial spur and secondary gear are solid, the speed of the latter is controlled by the ratio between the initial spur and the stationary internal gear. A small difference in number of teeth between the spur gear and the internal gear gives a large ratio and engages a large number of teeth, increasing the load-carrying factor. Efficiencies between 70 and 90 per cent with reduction ratios from 20 to 1 to 7,500 to 1 are claimed.

High-Speed Synchronous Motor

A NEW high-speed synchronous motor of "packaged" construction has recently been developed by Electric Machinery Mfg. Co., Minneapolis, Minn. The so-called packaged motor simplifies installation and wiring, reducing space requirements and lowering first cost for the motor equipment. External wiring for this motor is the same as for a squirrel-cage induction motor, the need for a separate panel-type control having been eliminated. The "packaged" motor consists of a fabricated all-steel motor of new compact design, with an exciter mounted on top and V-belt driven by the motor (or direct-connected to the motor), and a field control unit mounted on the motor for automatically applying and removing excitation for the field winding of the synchronous motor. Such motors are available in sizes up to 350 hp. at 1,800 r.p.m.

Equipment Briefs

A CHEMICALLY TREATED paper which changes from white to deep blue in color when its temperature rises above a certain fixed point, has been put on the market by the Nashua Gummed & Coated Paper Co., Nashua, N. H. This paper, known as Sure-Temp, has been developed for attachment to a surface for determining when the surface reaches a predetermined temperature. It is available for changing color at many different temperature limits. The paper has an opaque white coating of a material which is stated to melt sharply at a definite temperature, thus exposing the blue color.

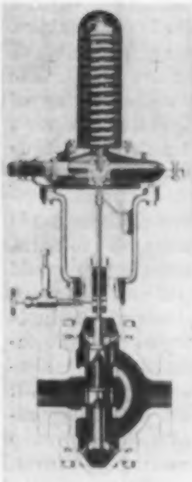
INDUSTRIAL protective clothing made of neoprene for resistance to oils, alkalis, acids and solvents which would disintegrate natural rubber, has been announced by the Industrial Products Co., 800 West Somerset St., Philadelphia, Pa. This clothing is manufactured in a two-piece style with all seams vulcanized. The jacket is provided with a low stand-up collar, snap fasteners, and a protecting fly front. The trousers are cut like overalls, with a bib front and adjustable suspenders. Small, medium and large sizes are available.

TO PROVIDE a leak-proof gage cock which can be completely opened or closed with one-quarter turn, the Merco-Nordstrom Valve Co., 400 Lexington Ave., Pittsburgh, Pa., has developed a lubricated plug type for test pressures up to 4,000 lb. Rated capacity on water, oil and gas, is 2,000 lb. A forged steel body, stainless steel plug and lubrication of the type used in this company's larger valves, are features. Available sizes are $\frac{1}{4}$ and $\frac{3}{8}$ in.

A NEW SERIES of automatic reset timers and time delay relays has been announced by the Paragon Electric Co., 37 West Van Buren St., Chicago, Ill. These instruments are used to close and then re-open a circuit; to open and then re-close a circuit; to make momentary contact; and to repeat a preset schedule of momentary contacts or timed off-and-on operations. These instruments are capable of resetting instantly after a power failure. A positive, magnetically operated mechanical lock is employed, eliminating possibility of disconnection due to vibration.

A LINE OF small electric furnaces measuring 3 by 4$\frac{1}{2}$ by 5 in., with the muffle rapidly and uniformly heated by a heavy Nichrome wire element, has been announced by the Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif. These furnaces are used for temperatures up to 1,800 deg. F. and are provided with an attached pyrometer. Being well insulated, they are said to require little power and no special wiring. Furnaces in other sizes and temperatures up to 2,800 deg. F. are available.

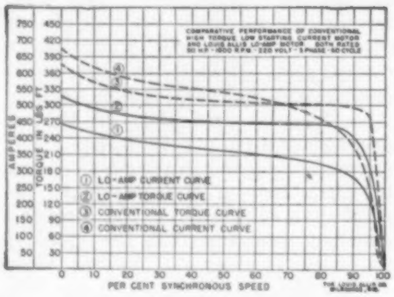
A NEW mercury-to-mercury temperature controller known as the Philadelphia Merc-to-Merc has recently been announced by the Philadelphia Thermometer Co., Philadelphia, Pa. This new instrument, which is stated to



Cross-section of separate-drive Redler

Redesigned Fulscope controller

Improved Stabilflo diaphragm valve



Curves comparing current and torque of conventional and Lo-Amp motors

have a sensitivity within 0.1 deg. F., consists of a mercury bulb with a glass partition through the center, making a double bulb to which is fused a double capillary stem. The two capillaries terminate in a junction within an upper glass bulb. Electrodes are sealed into the bores below the junction. Thus when the bulb is heated the two mercury columns rise in the bores, pass the electrodes and make contact at the junction, closing the circuit. These temperature regulators are available in both adjustable and non-adjustable forms. The standard type is suitable for temperatures to 700 deg. F., with 1,200 deg. F. instruments available in mercury-to-wire contact types. The mercury-to-mercury type features higher contact capacity than the mercury-to-wire type, avoiding use of an intermediate relay when employed with a mercury plunger relay available from this company.

The United States Stoneware Co., Akron, Ohio, has announced commercial production of ½-in. inside diameter porcelain raschig rings having a wall thickness of 1/16 in. These rings have a free space of about 55 per cent and a surface area, at 85,000 rings per cu. ft., of 212 sq.ft. per cu.ft. These rings, said to be the smallest ever made, are produced by an entirely new method.

Diaphragm Control Valve

Improvements in its line of Stabilflo diaphragm control valves have been announced by The Foxboro Co., Foxboro, Mass. The new valve features a rangeability of 50 to 1 and is available with V-port plunger, a parabolic type plug or a wide-ratio turned type of plug, depending on desired characteristics. The valve is designed for the high lift necessary for wide-range flow characteristics, twice the movement for the same air pressure range as in ordinary valves being attained, according to the manufacturer. The design is such that guides and anti-friction bearings are not required. A deep lubricated stuffing-box and polished stainless steel valve stem are said to reduce friction to the minimum. Top and bottom plunger guides of polished stainless steel and large bearing area are claimed to insure freedom from excessive wear.

Improved Redler Conveyor

Stephens-Adamson Mfg. Co., Aurora, Ill., has announced the development of a new style of horizontal closed-circuit Redler conveyor, which is said to assure absolute cleanliness and freedom from contamination. The new design features the driving chain moving in a compartment separate and distinct from the compartment handling conveyed material. This construction is said to eliminate any metal-to-metal contact in the carrying run of the conveyor, preventing possibility of dirt or lubricant from contaminating the material. The conveyed material is entirely free from metal-to-metal contact of sprocket and chain or chain and casing. The new Redler is said to retain the standard features of Redler conveyor-elevators such as inclosed and dust-tight construction, compactness, minimizing of breakage of conveyed materials, elimination of feeders, and self-cleaning action.

Improved Controllers

For the measurement, recording and control of temperature, pressure, flow and liquid level, the Taylor Instrument Cos., Rochester, N. Y., have introduced a completely redesigned line of Fulscope air-operated instruments, available in five standard types. These types include: fixed high sensitivity; adjustable sensitivity; adjustable sensitivity with automatic reset; adjustable sensitivity with a new factor known as "Pre-Act"; and adjustable sensitivity with automatic reset and Pre-Act. This new factor, Pre-Act, is a supplementary control feature which makes control valve corrections according to the rate of control-point deviation. This effect is said to reduce greatly the tendency to overshooting and oscillation on sudden process disturbances.

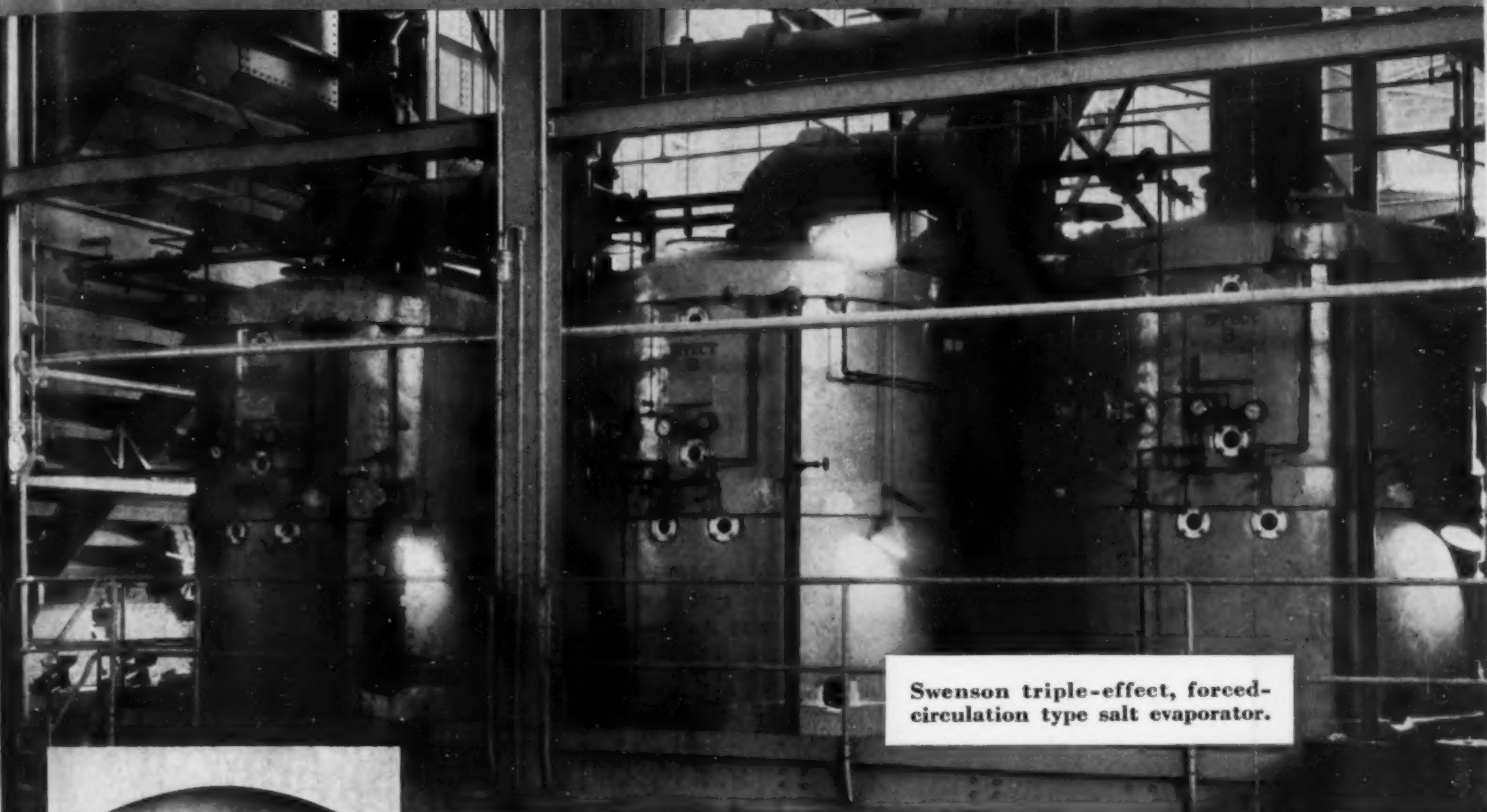
The automatic reset feature which compensates for load changes is located in the instrument case and is fully adjustable over a much wider range than previously. Throttling range adjustment over a wider range insures complete adaptability to process lag according to the maker, while fully pneumatic sensitivity reduction is said to give consistent controller performance throughout the entire sensitivity range and to provide inherent compensation for air supply pressure fluctuations. Other features include easy interchangeability in the field from one form to another, extensive use of 18-8 stainless steel, an improved relay air valve with sapphire orifice, and built-in auxiliary air filters. Easy maintenance is said to follow from simple design and ready accessibility for adjustments.

"Lo-Amp" Motor

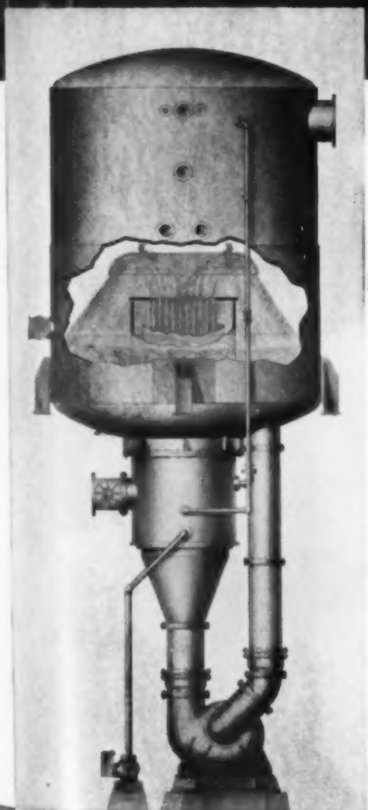
The Louis Allis Co., Milwaukee, Wis., announced recently the development of a new motor intended particularly for use in refrigerating and air conditioning installations, which features particularly low locked-rotor current and which can be supplied in either a high starting-torque type, or with normal starting torque. The new motor, known as the "Lo-Amp," is said to have the simplicity of a standard squirrel-cage motor and to require no centrifugal switches, relays, brushes or slip rings. No expensive special control is needed for starting.

Correction—In Dr. Ernst Berl's nomographic chart on the temperature correction of aqua ammonia densities, which appeared on page 788 of our issue of December 1939, the system of Baumé degrees used is the so-called "rational" Baumé system used abroad. This was not noted at the time the chart was translated from the original German edition. In this system specific gravity of a liquid lighter than water is 144.3/(144.3 + Bé. deg), while in the American system specific gravity is 140/(130 + Bé. deg.). Therefore, to correct the rational Baumé degrees shown on the nomograph to the American system, the following expression may be used: American Bé. deg. = 10 + 0.97 chart Bé. deg.

Evaporate Your Heavy, Viscous Liquors this LOW COST WAY



Swenson triple-effect, forced-circulation type salt evaporator.



Forced-circulation type evaporator unit—ideal for foamy, viscous liquors and for continuous operation with salting liquors.

Cut operating and maintenance costs with SWENSON Multiple-Effect Forced-Circulation Evaporators

For handling foaming viscous liquors or salting liquors that scale up ordinary types of evaporators, investigate the Swenson Multiple-Effect Forced-Circulation Evaporator. With this unit it is possible to concentrate liquors to high densities and viscosities. There is a marked reduction in the scaling or salting tendency and a considerable prolonged cycle between boilouts. Umbrella deflectors prevent entrainment losses.

The forced circulation also makes possible high capacity with less heat surface—thus permitting the use of low-maintenance materials. And, the multiple-effect keeps down steam and water consumption.

Swenson also designs evaporators of many other types. Let Swenson engineers study your evaporation problems. Their recommendations will be based upon years of specialized experience and research.

SWENSON EVAPORATOR COMPANY

(Division of Whiting Corporation)
15669 Lathrop Ave., Harvey, Ill.

SWENSON

EVAPORATORS—FILTERS—CRYSTALLIZERS

Engineered Individually for Your Plant

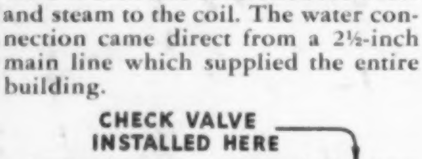
"Accidents like this can cost us a fortune," excitedly shouted the PLANT SUPERINTENDENT.

"How in blazes did steam get into that drinking fountain," woefully spoke the MAINTENANCE FOREMAN.

"But it won't happen again," assured the CRANE MAN. "Preventive Maintenance will see to that."

IN a midwestern manufacturing plant one day, a worker went for a drink. But, as he stooped over the fountain, instead of refreshing water, there came a blast of burning, blinding steam.

In another department, silicate of soda used for processing was melted in a large vat with a steam coil. The liquid was then cooled by running water through the same coil. A globe valve in each line controlled the water and steam to the coil. The water connection came direct from a 2½-inch main line which supplied the entire building.



A batch of the processing material had been melted and was ready for cooling. The water valve was opened wide. But, the operator forgot to close the steam valve. The 160-pound steam easily forced its way into the water line. And, it was the thirsty worker who provided an outlet for the angry vapor.

"This must never happen again!" said the Superintendent. A warning to the vat handlers wasn't enough. So he called in W. F. C., the Crane Man, who suggested Preventive Maintenance. The solution to the problem was simple, yet Preventive Maintenance would safely guard against recurrence. It counseled the installation of a Crane No. 74E Brass Check Valve in the water line to the processing vat.

Results: (1) the trouble was permanently remedied. (2) The management has peace of mind about the safety of its employees from this danger. (3) Another manufacturer has learned the sound economy of Preventive Maintenance. Has learned, too, to look to Crane for the valves and fittings for the most economical solution to every piping problem. And, he knows it pays to consult the Crane Representative—always.

This case is based on an actual experience of a Crane Representative in our Kansas City Branch.

CHECK VALVES ARE "TRAFFIC COPS" IN PIPE LINES

In industry there are few piping systems, if any, in which backflow is not dangerous or damaging. Thus check valves are often the most essential valves in a line. They police your piping—keep flow going in the right direction.

Systems lacking adequate backflow control afford the Plant Engineer a valuable opportunity to apply Preventive Maintenance now—before costly damage results to product or equipment, or harm to personnel. To meet the varying operating conditions of industrial piping, Crane makes check valves in a complete range of designs and materials—for all working pressures.

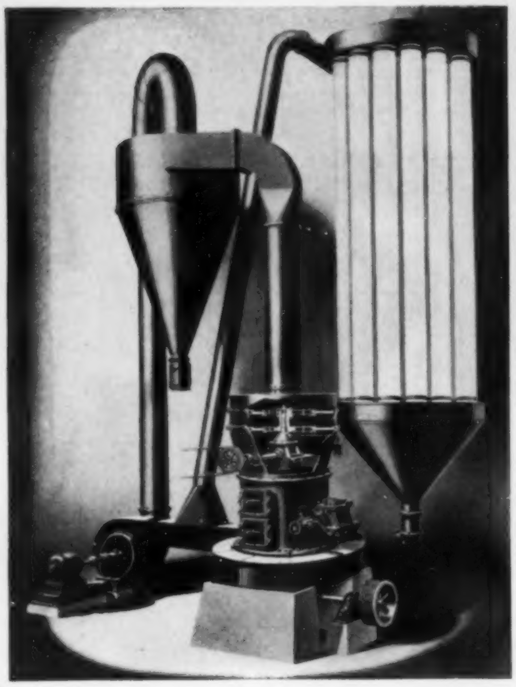
You'll get a lot of satisfaction in Crane No. 74E Brass Check Valves. They're rated at 300 pounds steam, 550°, and are built to give superior service. For steam, water, oil or gas lines, they're an outstanding buy. Consult your Crane Representative.

CRANE

CRANE CO., GENERAL OFFICES
836 S. MICHIGAN AVE., CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

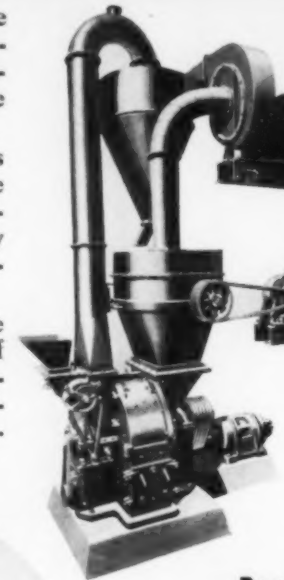
MAKING *Superfine*... MATERIALS *is a* RAYMOND JOB



RAYMOND engineers have specialized in the development of pulverizing and separating machinery for more than half a century.

Their long experience, plus the advantages offered in the latest types of equipment, provides the real answer to many difficult problems of production.

If you are engaged in the manufacture of any kind of powdered materials, which require drying, grinding, classifying . . . write for a Raymond Catalog.

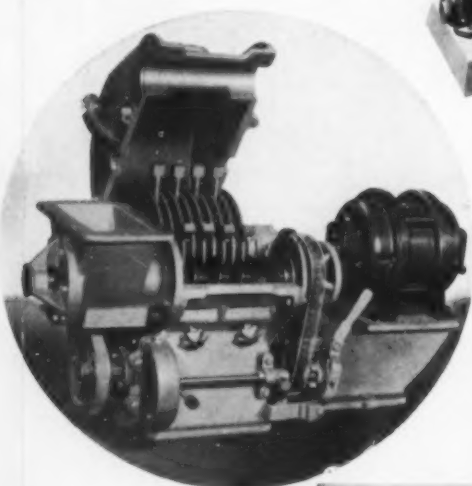


Raymond ROLLER MILL
with
Double Whizzer Separator

You can produce a variety of grades with this one machine . . . from 80% minus 100-mesh to 99.9% passing 325-mesh . . . merely by changing the setting of the whizzer speed control dial on the driving transmission. Greatly increased capacities per horse-power give unusually low tonnage costs. Highly economical for pigment grinding and many other operations.

Raymond IMP MILL
Whizzer-equipped
Flash Drying, optional

A compact unit for many special grinding applications. May be used for drying, pulverizing and separating in one operation. Also for cooling materials to prevent stickiness in grinding. Efficient for removing water of crystallization from copper sulphate in making a fine powdered product for insecticides.



Raymond SCREEN MILL

For reducing soft materials to uniform fineness. Built in five sizes for capacities from a few pounds to several tons per hour.

Raymond LABORATORY MILL

This produces the *same character* of material as large commercial pulverizers . . . therefore valuable for a pilot mill in running tests or developing new products.

SINCE 1887

RAYMOND PULVERIZER DIVISION

COMBUSTION ENGINEERING COMPANY, INC.

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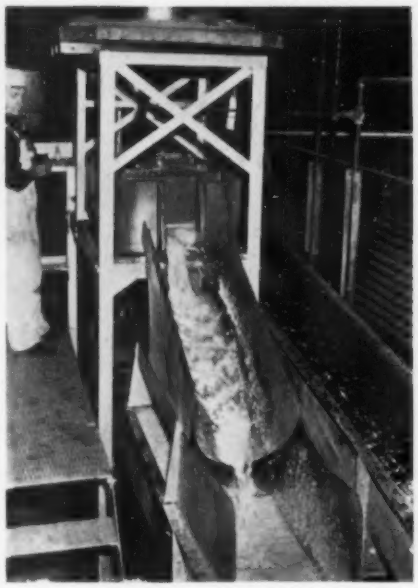
LACTIC ACID AND CASEIN

MILK is becoming an important source of chemical materials. Most of the development has been as byproducts of the dairy industry so as to obtain profits from materials that formerly went to waste. Probably the most active and successful organization in this field is the Sheffield By-Products Co. of Hobart and Norwich, New York, a subsidiary of Sheffield Farms Co. and, in turn, of National Dairy Products Corp. Among the products that are being made in these plants are casein and lactic acid.

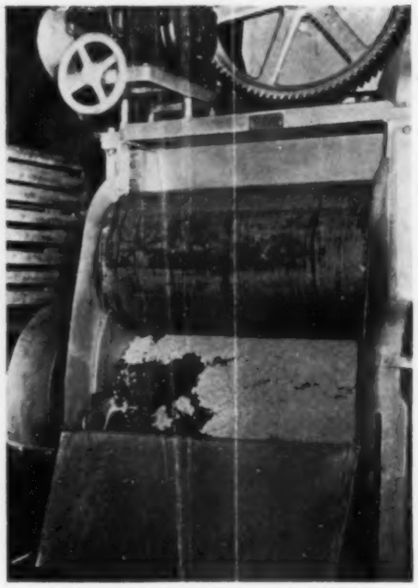
The casein is produced by a continuous technique and mechanism which is amazing in its simplicity. The machine that was specially developed for the purpose has a capacity of 25,000 lb. of skim milk per hour, yielding about 2.75 per cent casein. It occupies a floor area about one-half that of the original machine. Head room, also has been decreased by a third. The process depends on continuous reaction between minute quantities of milk and acid. As a corollary of continuous reaction has come continuous draining of the whey and washing and pressing of the casein. The process is described in detail in *Chem. & Met.*, Vol. 41, p. 644–46.

The whey which is drained from the curds in the making of casein is used in the production of lactic acid. The fermentation process employing lacto-bacillus plus a mycoderm is started in the laboratory, using as a culture pasteurized skim milk. The culture is inoculated in large vessels of the milk and these in turn are used to inoculate raw whey. Liming is made to prevent lactic acid concentration from increasing beyond about 1.3 per cent. The calcium lactate is purified, concentrated and crystallized to make the U.S.P. grade. This lactate is dissolved and treated with sulphuric acid to form the lactic acid. The acid is purified by decolorizing with activated carbon to make the 50 per cent water white grade. For more information about the process see *Chem. & Met.*, Vol. 43, p. 480–83.

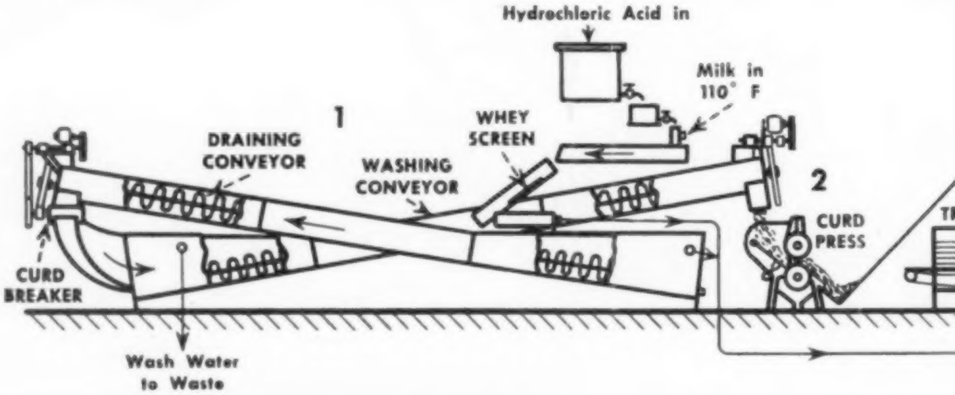
CHEMICAL & METALLURGICAL ENGINEERING
JUNE, 1940 • Pages 427–430



1 Skim milk and hydrochloric acid react in a special mixing device resulting in the formation of "curds and whey". The curds are then separated from the whey in an inclined screw conveyor and pass on to a similar conveyor in which they are thoroughly washed

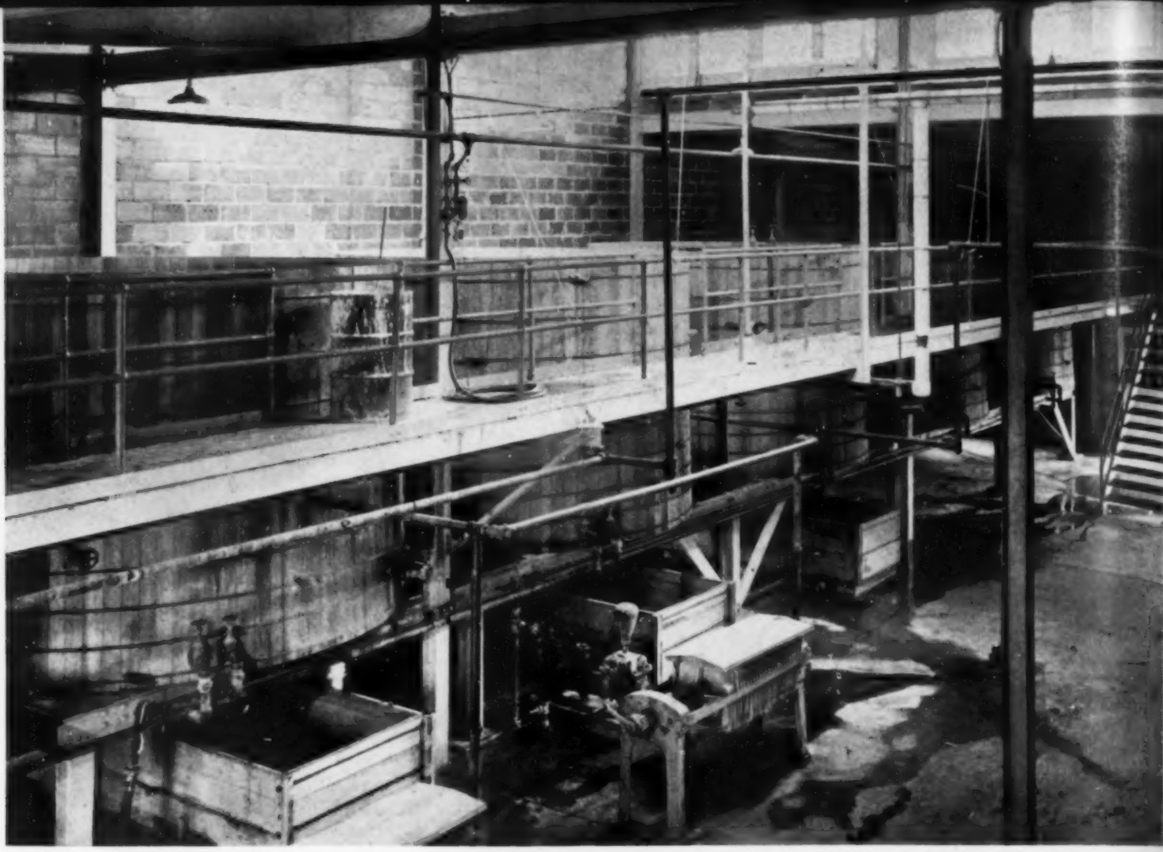


2 After the casein curds are washed they are fed into a two-roll continuous press where the water content is reduced to about 50 per cent. The curd is scraped from the lower roll by a wooden knife and discharged to the next operation, drying

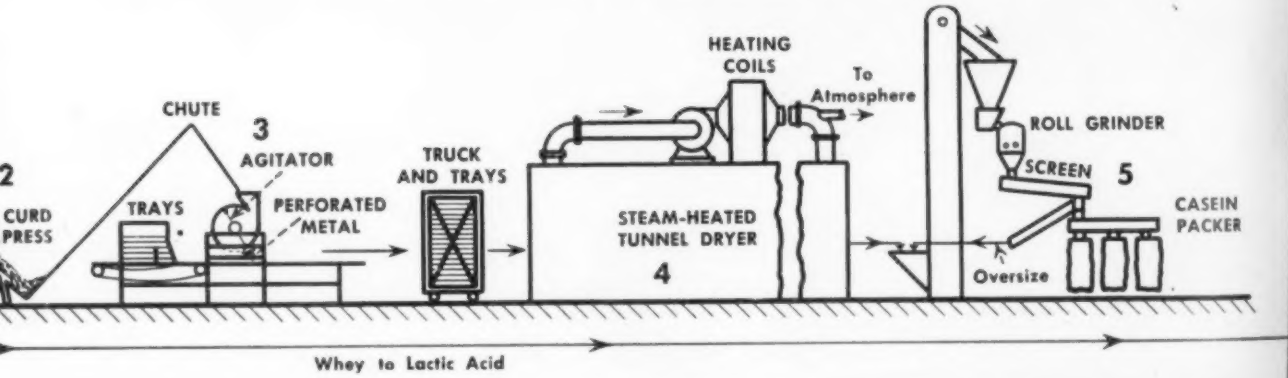


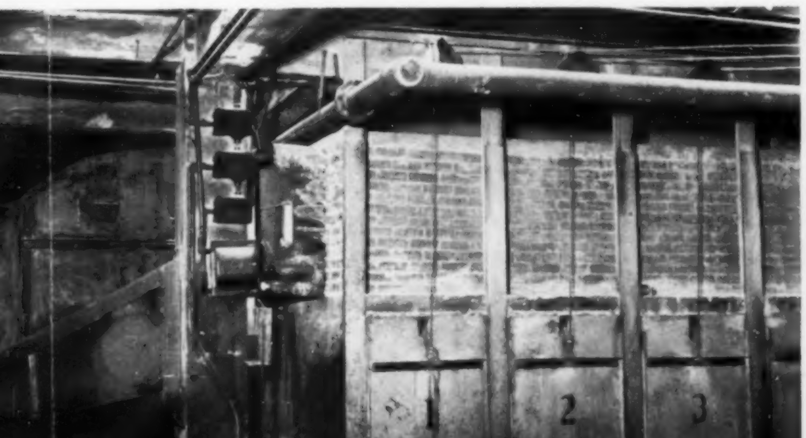
3 An automatic device is used to grind the curds finely and at the same time to spread the casein uniformly on the trays on which it is to be dried

4 A tunnel kiln drys the casein. It is steam heated. Trays containing the wet casein enter the dryer stacked on trucks

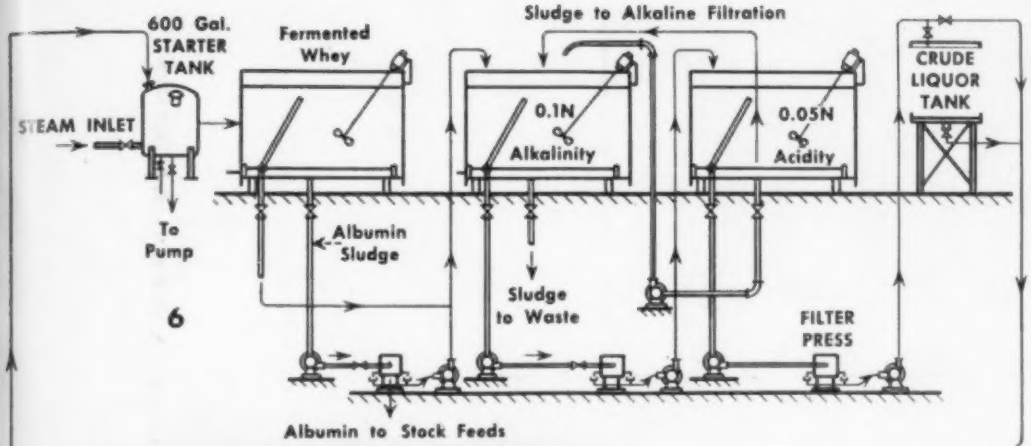


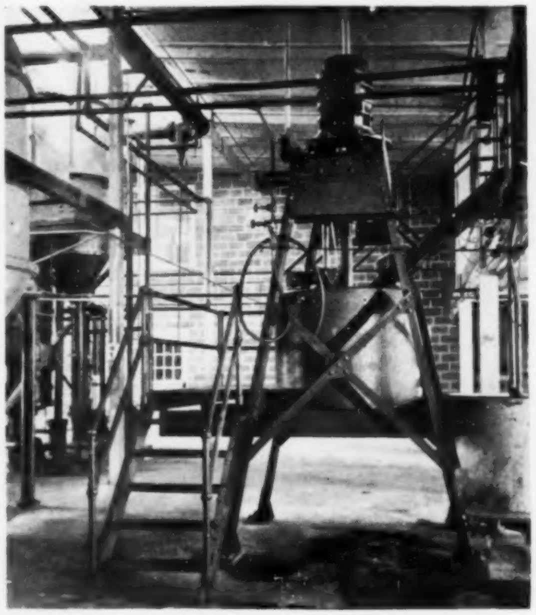
6 Fermentation of the whey is carried out in 7,000 gallon wooden tanks. The lactose is converted into lactic acid, and subsequent liming neutralizes the acid forming calcium lactate. On completion of fermentation the albuminous matter is coagulated by heating the fermented liquor with live steam

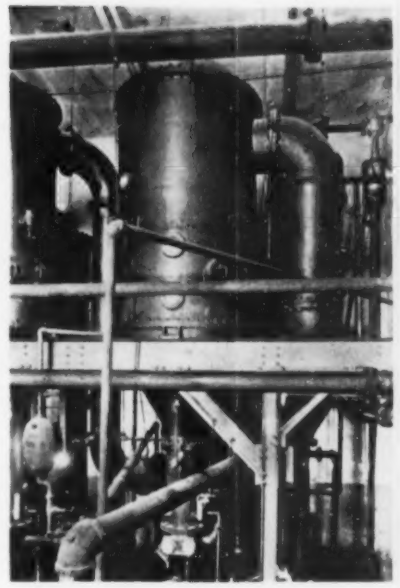




5 After drying the casein is ground in a disk mill, passed through a gyratory screen and finally packaged in three-walled paper bags

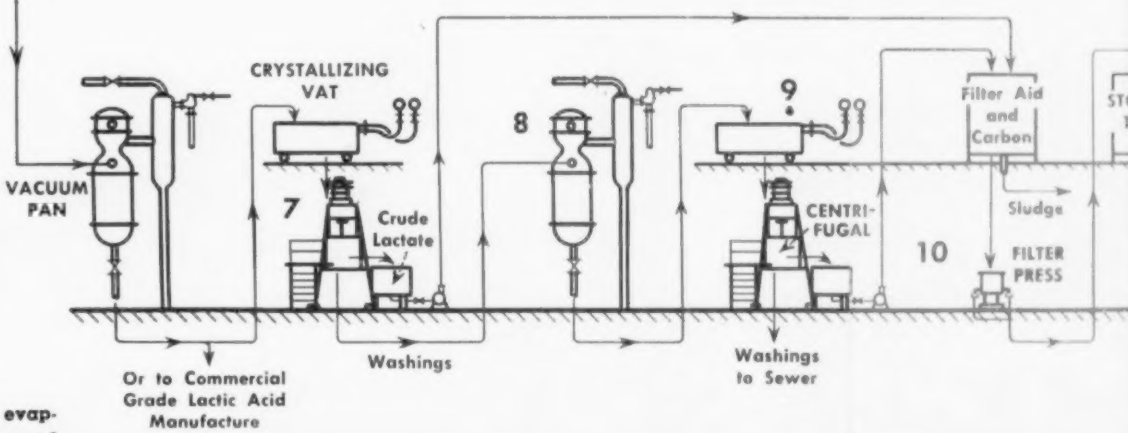






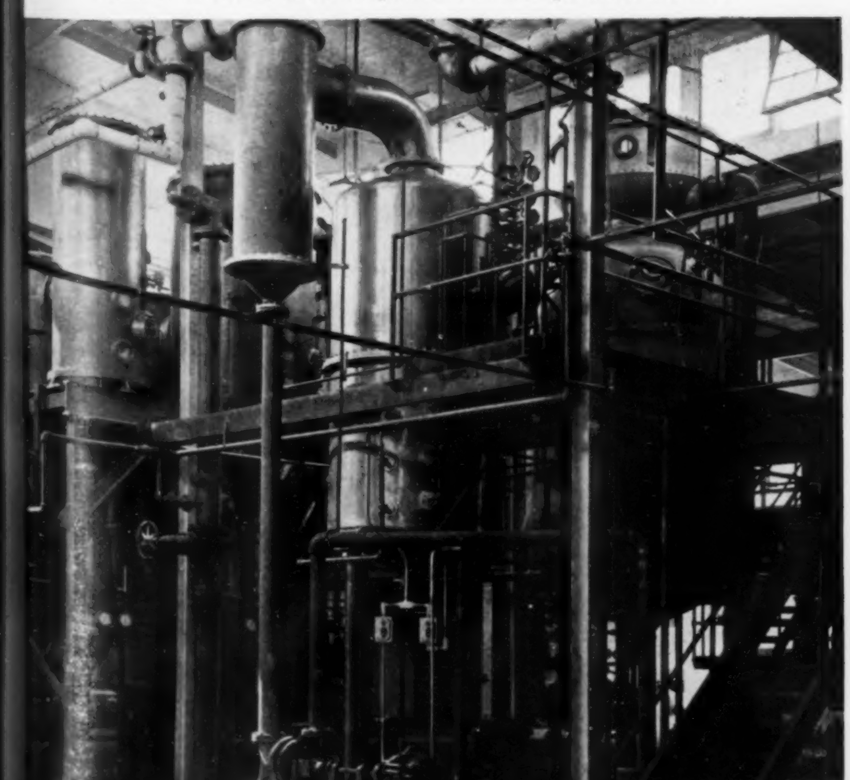
11 The lactic acid is concentrated to a 50 per cent solution in a double effect and a single effect evaporator

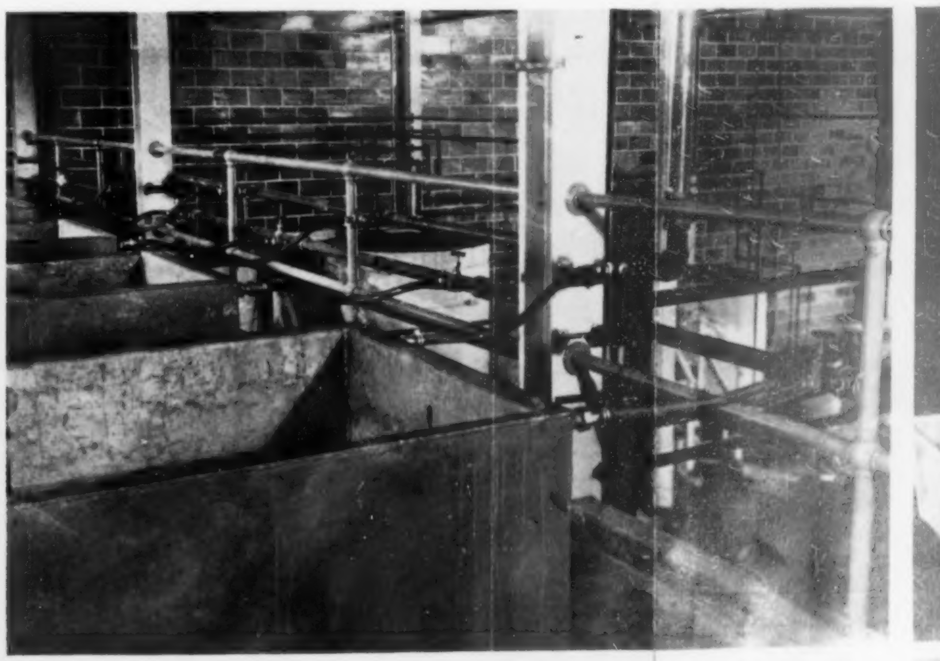
12 The mother liquor is se... the calcium lactate crysta... step in the centrifuging ope...



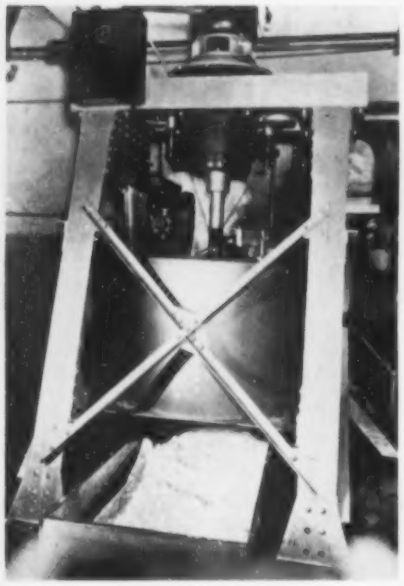
7 Calcium lactate crystals are separated from the mother liquor in a centrifuge. Before removing from the centrifuge the crystals are washed with water

8 The calcium lactate liquor is concentrated by vacuum evaporation. A double effect evaporator and a single effect are used



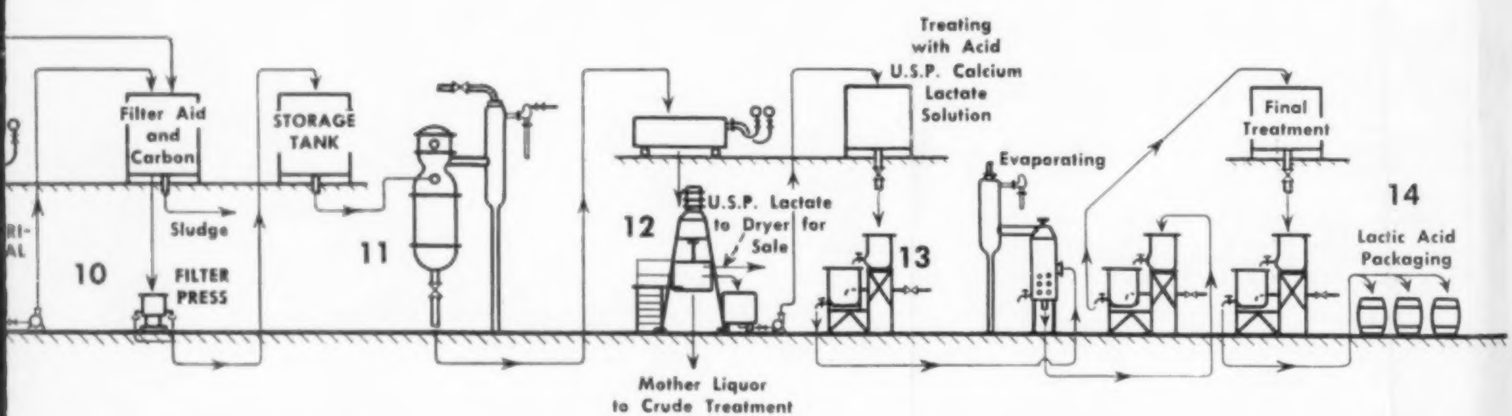


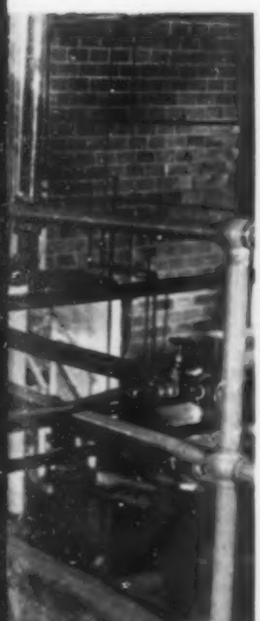
9 After concentrating the calcium lactate liquor it is necessary to crystalize the product. For this purpose water jacketed, portable crystallizing vats are used



12 The mother liquor is separated from the calcium lactate crystals as a first step in the centrifuging operation

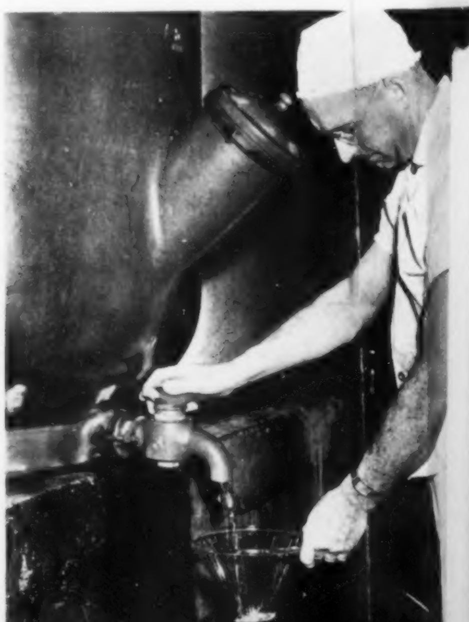
13 In the production of water white lactic acid, a U.S.P. calcium lactate solution is reacted with concentrated sulphuric acid. After the sulphate is filtered off the filtrate is run to a tank where it is agitated with activated carbon which is finally removed by filtration





crystalize the product.
d

10 Decolorizing material, activated carbon, is separated from the lactate liquor in a filter press



14 Final barreling of the water white lactic acid after filtraton

Chem & Met PLANT NOTEBOOK

Timesaving Ideas for Engineers

POINTERS ON THE CHOICE OF REDUCING VALVES FOR SUPPLYING PROCESS STEAM

JAMES O. G. GIBBONS *Mechanical Engineer, Bloomfield, N. J.*

When considering the size and type of reducing valve best suited to supply process steam to any particular job, there are at least four points which should be kept in mind.

1. In passing through a reducing valve, the steam becomes superheated.
2. Superheat may be an advantage under certain circumstances, but in process work, it is almost a disadvantage if it is allowed to reach the heating element.
3. Oversized valves are likely to be damaged through wire drawing; moreover, on light loads they do not regulate well.
4. A double-seated valve cannot be relied upon to shut off tight.

Failure to give proper consideration to any of the above factors may lead to considerable trouble, so it will be well to discuss them in more detail.

1. In passing through a reducing valve, the steam does not lose any appreciable amount of heat. It is true that theoretically a small fraction of the heat is converted into mechanical energy, but this loss is so small that it may generally be ignored. Assume that we have steam at 100 lb. gage pressure and that we install a valve to reduce the pressure to 20 lb. The total heat (enthalpy) of saturated steam at 100 lb. gage is about 1188.7 B.t.u. per pound, and that of saturated steam at 20 lb. gage, about 1166.7, so we have more than 20 B.t.u. for superheating the steam. With the specific heat of saturated steam around 0.5, we should get about 40 deg. of superheat, producing a temperature of nearly 300 deg. F.

2. Superheat may be very useful in drying steam and in re-evaporating condensation. As a rule it is not necessary to install a trapped drip near the outlet of a reducing valve, even if there is a rise in the main, as the superheat will re-evaporate the entrained water. Moreover, a low pressure thermostatic trap is likely to be damaged by the superheat. If a trap must be installed, one should be used that will stand a high temperature and at the same time handle low temperature steam, if necessary.

Superheat reduces the effectiveness of any heating element supplied with it and if this is not taken into consideration, the heating effect may be considerably less than figured.

3. Unless exact data are obtainable from the manufacturer, it is not posisible to calculate the actual capacity of a reducing valve from its nominal size. There are several capacity tables which are supposed to apply to all makes of valves, but these probably do not accurately apply to any.

If the equivalent area of the orifice is known, the capacity can be approximately figured by means of Napier's formula for steam flow through orifices. However, if you can get the orifice size, you can probably get the capacity of the valve from the same source. The thing to remember is that valves of the same nominal size may differ considerably in capacity.

Generally it will be found that valves having half the nominal size of the supply pipe will be of ample capacity. Of course a certain amount of pressure drop in a reducing valve is permissible and the more nearly the valve works to full opening, the better will be the regulation and the less the damage to the seat though wire drawing.

4. In process work it is sometimes necessary to supply steam to one piece of equipment through an individual reducing valve. Generally double-seated valves are much cheaper to install than those with single seats, owing to the fact that, except in very small sizes, a single-seated valve has to be pilot operated. Since it is almost impossible to make two disks mounted on the same stem seat exactly tight at the same time, there is generally a slight amount of leakage when the valve shuts off. In cases such as this pressure may build up to a dangerous degree on the low pressure side. On such "dead end" service single-seated reducing valves should be used and in most cases they should be pilot operated.

Hot Conveyor Lubrication

An interesting solution to the problem of obtaining smooth operation of heavily loaded conveyors carrying ceramic parts through high temperature furnaces has recently been worked out at the plant of the Champion Spark Plug Co., Ceramic Division, Detroit.

Two identical continuous chain-driven conveyors with a total length of 275 ft. carry spark plug insulator "decorating setters" up to and away from an 1,800 deg. F. kiln at this plant for the firing on of type and trade marks in overglaze colored enamel. The conveyors are fitted with flat plates designed to support special nickel-iron trays loaded with insulators.

These plates slide on horizontal guide plates on both sides of the entire length of the conveyor—from loading stations through the kiln and back through a cooling zone to final inspection, where insulators are removed and trays reloaded.

Driven by a 2½-hp. motor, the slow moving conveyors, when first installed, had a tendency to move in small jerks rather than smoothly. Complaints of headaches on the part of operators sitting facing the conveyor inspecting insulators were suspected of being traceable to this motion.

Normally, conventional lubrication of the guides might have taken care of the situation. Two factors, however, obviated the use of customary oil or grease lubrication: (1) grease or foreign matter could not be permitted where it might get on the ware, and (2) conventional lubricants would burn off, carbonize and flake as the red hot setters were carried from the kiln to the cooling chamber.

The problem was solved through the development of a method of dry lubrication, using a lubricant impervious to heat. At a point just beyond where the conveyor leaves the kiln, two automatic Norgren lubricators of the air-operated spray type were installed in such a manner as to spray "dag" colloidal graphite suspended in carbon tetrachloride directly on the lower bearing surfaces and chain links of the conveyors as the plates passed over the lubricator.

Since at this point the conveyor has a temperature of around 375–400 deg. F., the carbon tetrachloride evaporates almost instantaneously, leaving a coating of dry graphite on the wear surfaces. A small amount of kerosene and oil is added to the carbon tetrachloride to slow up evaporation slightly and allow the graphite to cover completely and lubricate the bearing surfaces.

When first installed, the automatic lubricator was operated periodically during the day. Since then, it has been found that operating it for a short period once a day is adequate to maintain complete lubrication as the colloidal graphite adheres firmly to the surface to give satisfactory 24-hour lubrication.

The resulting smooth operation of the conveyor was accompanied by a sharp drop in headache complaints and, incidentally, also reduced power consumption materially.

Chem & Met NEWS

News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

WASHINGTON received two great shocks during May. One came from the military successes of the Germans in Holland and Belgium. The other came from the American people. Washington politicians were almost as much stirred by the second as by the first.

Until May, Washington leaders had been hesitant in talking preparedness, and absolutely tongue-tied on subjects of new taxation. Then they were rudely awakened to find the American people had outdistanced the political leaders in their thinking as to both the need for preparation and the need for new taxes to pay part of the bill. Not for many years have the politicians found themselves in their thinking so far back among the stragglers.

The President's two defense messages to Congress and his fireside chat were clear evidence of executive scramble to catch up. Congressional leaders furnished an equally hurried effort when they brought to the White House a proposal that the public debt limit be increased by three billion dollars, and that three billion dollars in new defense taxes be immediately imposed.

As this is written, it is difficult to say just what will be the outcome in many particulars. The one sure thing is that large new spending in the name of defense will be undertaken, and that some new taxes will be imposed. But the new taxes will not be nearly enough to offset the spending. So the public debt will continue to rise several billions more during the fiscal year which begins July 1.

Congressional Plans

All of the definite understandings of April regarding the remaining legislative program have been discarded. The numerous "promises" of adjournment not later than June 8 are withdrawn. All ordinary legislative plans have been laid aside. Only the measures which can be geared into the preparedness program are receiving serious attention. A few other bills, those not too controversial, will probably work their way through. But they will be relatively unimportant in number or scope as compared with the plans of a month ago.

It is freely forecast about Washington that "a special session is necessary." Even those who do not want such a session before election think that the President may be compelled to convene Congress again in the early fall. If that is done, the measures which were expected to die with June adjournment can still be carried forward to enactment. Even a lame-duck session after November 5 would take up such measures at the point where they are laid aside by recess or adjournment. It is a mistake to assume that such considerations make likely the enactment of very many pending bills. The chance of enactment is one of possibility, not probability.

Among the measures that seem to have been pigeon-holed for the balance of this Congress are all of those which were intended to revise NLRB or Wage-Hour Division laws. There is little hope for the Walter-Logan bill, largely because Administration leaders secretly oppose it, even when a few talk for it publicly. Further reform measures wanted by New Deal zealots are most unlikely. But equally improbable is the enactment of any legislation curtailing existing New Deal laws. Preparedness effort has, in other words, more or less frozen the legislative situation with respect to everything not connected with planes, tanks, guns, and strategic materials.

Government Buying

Chemical process industries will be delighted to know that an able chemical executive is to be Director of Procurement of the government. Donald M. Nelson, executive vice-president of Sears-Robuck & Co., and a graduate and experienced chemist, has been drafted by the President for this job, succeeding naval Captain Collins. The work will, of course, continue in the Treasury Department under Secretary Morgenthau and the Secretary is really the dominant procurement officer even for military needs, superseding in many particulars the Secretaries of War and Navy.

The only chemical which Washington talks much about as being seriously short from the standpoint of military supply is toluol. Strenuous effort is, therefore, being made for expanding production by modified practices of coke ovens, by installation of some new recovery plants, and by commercialization of new synthetic processes which the petroleum industry is likely to develop.

The list of strategic materials as defined by the Army and Navy Munitions Board has been somewhat shortened with the removal of aluminum, optical glass, and wool from that primary list into the secondary list of "critical materials." And eight items of the critical list have been deleted, namely, cadmium, coffee, cryolite, flaxseed, fluorspar, nux vomica, scientific glass, and titanium. The old list of "essential" materials is no longer emphasized by military authorities. The importance has not diminished but the need for military attention seems to be somewhat lessened.

Chemical Labor Trends

Since the Supreme Court ruled that the Apex Hosiery Co. could not claim triple damages under the antitrust statutes, the Department of Justice concludes that labor groups involved in jurisdictional disputes may not be so controlled. However, when labor groups are involved in commercial conspiracies, they are still subject to this law, it appears.

The Supreme Court also makes it clear that only these motor carrier employees over whom I.C.C. has assumed jurisdiction are subject to the transportation laws as they affect hours of employment. At present this means that truck drivers operating privately owned trucks in any way affecting interstate business are subject to the 10-hour day and 60-hour week. But all other workers of the same companies are under the Wage-Hour rules of the Department of Labor. Incidentally, this latter division has fixed tentative minimum wages under the Walsh-Healy law for the leather manufacturing industry, at 40 cents an hour. As it now stands, this is a recommendation of the industry

committee No. 10 which is subject to further hearings and review before final orders of the Department.

Proceedings are continuing for the fixing of definitions for manufacturing industry with respect to "executive, administrative, and professional" employees. When drafted, the new definitions will determine which workers are exempt from the maximum work week without over-time requirement.

Washington notes that the A. F. of L. headquarters in the Capital City are working definitely on a program of further chemical unionization. The chemical industries are very broadly defined. Apparently some of the first effort is to be placed on the process divisions, such as fertilizer manufacture, where below-average wages are paid.

Chemical Miscellany

The liquid oxygen and carbon explosives tested for Mr. Barlow proved to be very unimpressive. On the first effort, the headlines indicated that Mr. Barlow blew up but his explosive did not. Later tests seem to have convinced even friendly congressmen that the Army and Navy has not been missing any important bets by ignoring this development.

Government officials emphasize the fact that those seeking posts as chemists, chemical technologist, or chemical engineer in the government organization should prepare their applications for Civil Service rating to reach Washington before June 24, or June 27 in the case of some Western states.

Dr. R. R. Sayers, first named as acting director, has since been confirmed by the Senate as Director of the U. S. Bureau of Mines. A special proviso of the Interior Department appropriation bill protects Dr. Sayers' standing as a member of the commissioned officer staff of Public Health Service.

The request of Manufacturing Chemists Association has been approved by I.C.C. with respect to lead frangible discs in sulphuric acid tank cars. It is now permitted that experimentally 500 cars may be equipped with such discs perforated with $\frac{1}{16}$-inch ventholes. The anticipated benefit is the release of any gas pressure generated within the tank by interaction of the acid on the steel. This eliminates hazards to workmen engaged in unloading.

Unlawful price-fixing conspiracy in the sale of certain agricultural chemicals is charged against numerous makers of insecticides, fungicides, and similar commodities by a Federal Trade Commission action of June 1. Involved are about 30 companies and the trade association "Agricultural Insecticide and Fungicide Association" of New York City and its officers and directors. Maintenance of uniform prices is the major charge.

Chemical price index quotations by the Department of Labor are now based on a new list of individual commodities. Those interested in interpreting government figures published monthly will find a description of the new quotations in the March 1940 issue o. "Average Wholesale Prices and Index Numbers of Individual Commodities," issued from the office of Jesse M. Cutts in the Bureau of Labor Statistics.

Potash marketing policies were thoroughly studied by a special group under Dr. Willard L. Thorpe of the Department of Commerce. The report of early May was followed shortly by a consent decree in a federal court. The result is that certain modifications in the pricing of potash chemicals have been made. This will permit quotations on bases which the government and the courts seem to feel would be more favorable to certain agricultural purchasers. Those interested in the structure of this industry and its marketing practices will find considerable interest in the special report submitted to the Department of Justice by the Department of Commerce under the date of May 1.

CARBIDE AND CARBON CHEMICALS BUILD PLANT AT TEXAS CITY

Announcement was made on May 31 that initial construction would start June 1 on the Texas City chemical plant of Carbide and Carbon Chemicals Corp., a unit of Union Carbide and Carbon Corp. The Texas City plant will be located on a tract of land about midway between Texas City and La Marque. The site comprises about 200 acres just south of the "County Road," between the properties of Pan-American Refining Corp. and the Southern Pacific Railroad.

In addition to buildings in which chemical processing operations will be carried out, a steam plant and a compressor station using gas engine driven compressors will be constructed at this time. All buildings will be of the most modern type of reinforced concrete, brick, and steel construction. The plant office building will face the "County Road" and the remaining buildings will extend to the south through the center of the property.

The purpose of the plant is to manufacture synthetic organic chemicals from refinery gases to be supplied by Pan-American Refining Corp. This arrangement for obtaining raw materials is similar to that at the Whiting plant of the Chemicals corporation, where gases are obtained from the adjacent refinery of Standard Oil Co. of Indiana. At the Texas City plant, a variety of industrial chemicals will be produced.

PROF. V. N. IPATIEFF RECEIVES WILLARD GIBBS MEDAL

Prof. Vladimir N. Ipatieff, director of chemical research of Universal Oil Products Co., professor of chemistry at Northwestern University, and a chemist of international distinction is the recipient of the 1940 Willard Gibbs Medal. The medal is awarded annually by the Chicago Section of the American Chemical Society for conspicuous contributions in chemistry. It was presented at a dinner meeting of the Section at the Stevens Hotel, Chicago, on the evening of May 24. Presentation was made by Prof. S. C. Lind, president of the American Chemical Society.

Professor Ipatieff has been honored by various institutions for his achievements, the latest award being the honorary degree of Doctor of Chemistry conferred on him by the University of Sofia, Bulgaria, during his visit to that country last year.

Among other honors that have been conferred upon him are: correspondent member, Doctor Honoris, University of Munich, Germany; honorary member of Deutsche Chemische Gessellschaft, Germany; Doctor Honoris, University of Strasbourg, France; Commander, Legion of Honor, France; and Berthelot Medalist, France, 1928. He was recently elected a member of the National Academy of Sciences.

NEW PLANT FOR SODIUM SULPHATE IN CALIFORNIA

Construction of a large plant for production of anhydrous sodium sulphate, at Dale Lake, Calif., is being rushed by Desert Chemical Co. An analysis of markets for this product is being made, which will determine the extent of 1941 production. Contemplated for 1941 is 50,000 tons, but this can be increased materially should conditions warrant. Approximately five thousand tons will be available for sample shipments by the middle of July this year.

S. Lee Richardson is president and production manager of the company, and other officers include vice-president George Pepperdine, head of the Pepperdine Foundation; vice-president M. Christenson; secretary, Henry D. Dargert, an official of Flotations, Inc., and Bardco Co.; treasurer, C. P. Shattuck.

CHEMICAL MANUFACTURERS MEET AT SKYTOP

Contrary to early forecasts by outside sources, the American chemical industry has received no substantial orders from the Allies. Increased exports to South American countries have somewhat offset the loss of European and other markets. In contrast with conditions during the first World War, chemical prices have held relatively stable and there has been no serious disturbance of the chemical consuming industries. Thus Chairman Harry L. Derby of the executive committee of the Manufacturing Chemists' Association highlighted his report to the association's 68th annual meeting held at Skytop, Penna., June 6 and 7.

More than 200 members and guests attended the business session at which President Lammot duPont introduced as guest speakers, Prof. J. Anton de Haas of the Harvard Graduate School of Business and Dr. James S. Thomas, president of the Chrysler Engineering Corp. and of Clarkson College of Technology. Dr. Harold G. Moulton, president of Brookings Institution, addressed the union dinner with the Synthetic Organic Chemical Manufacturers Association. He discussed the need for further capital expansion to continue our growing economy.

Prof. de Haas, whose special field is that of international relationships, foresees drastic economic changes as the result of the European war. A German victory would mean the control of colonial resources and enforcement of a barter system whereby the world would be compelled to trade on German terms for tin, rubber and other essential commodities. Gold under such conditions would become practically valueless as a medium of exchange. Even an Allied victory would raise the question of whether a free economic system can survive because England and France already have put their industries and dominions under cartelized control. Whether we like it or not, self-sufficiency will be forced on us by the permanent loss of our foreign markets and sources of supply according to Prof. de Haas.

Dr. Thomas had for his subject "Culture and the Market Place." An able student of history and a thorough believer in technical progress, he showed in a most entertaining way how all of the cultural advances of the world have been financed by successful business enterprises. Ours is the greatest of all time because it is shared not by a few thousands as in the Rennaisance and the Elizabethean revival but by at least 30 million Americans.

Lammot duPont, chairman of E. I. duPont de Nemours and Co. was reelected president of M.C.A. with George W. Merck of Merck and Co., and Charles Belknap of Monsanto Chemical Co. as vice-presidents. J. W. McLaughlin of Carbide and Carbon Chemicals Corp. and Warren N. Watson were continued as treasurer and secretary, respectively. J. H. Dunbar retired from the executive committee and two new members were added—Major T. P. Walker of Commercial Solvents Corp. and C. F. Hosford, Jr. of Pennsylvania Coal Products Co.

TESTIMONIAL DINNER HELD IN HONOR OF PROFESSOR BARTOW

A testimonial dinner was held in Iowa City, Iowa, May 21, to honor Professor Edward Bartow, who retires

Portrait of Prof. Edward Bartow

this month as head of the Department of Chemistry and Chemical Engineering at the State University of Iowa. Several hundred friends and alumni joined in presenting the University with a portrait of Dr. Bartow, recently completed by Aden Arnold of the Art Faculty of the University of Montana. The presentation was made on behalf of the group by Sidney D. Kirkpatrick of *Chem. & Met.* who served as one of "Bartow's Boys" in the Illinois State Water Survey and later in the A.E.F. He also announced the establishment of the Edward Bartow Prize Fund for Iowa Graduates in Chemistry and Chemical Engineering.

WALTER S. CARPENTER, JR., ELECTED PRESIDENT OF DU PONT

Pierre S. du Pont retired as chairman of the board and Lammot du Pont resigned as president of E. I. du Pont de Nemours & Co. at a meeting of the board of directors held in Wilmington, May 20. Lammot du Pont was elected chairman of the board. Walter S. Carpenter, Jr., a vice-president, was made the president of the company.

Irénée du Pont, a former president of the company, resigned as vice-chairman of the board of directors. No appointment was made to this position. He as well as Pierre S. du Pont will continue as members of the board and of the finance committee, on which Lammot du Pont also will serve.

Mr. Carpenter, in accepting the presidency of the company, resigned as chairman of the finance committee. Angus B. Echols, a vice-president, was elected chairman of the committee. J. B. Eliason, treasurer of the company, was elected a vice-president and a member of the board of directors. Mr. Eliason will continue to serve as treasurer.

DR. GARDNER HEADS NEW YORK CHAPTER OF A.I.CH.

The New York Chapter of The American Institute of Cemists held a business meeting and informal dance at the Hotel Capitol, New York, on Wednesday, May 22.

The following new officers were elected: chairman, Dr. William Howlett Gardner, supervisor, Shellac Research Bureau, and research professor at Polytechnic Institute of Brooklyn; vice-chairman, Dr. W. D. Turner, assistant professor of chemical engineering, Columbia University; secretary-treasurer, D. H. Jackson, vice-president, Croll-Reynolds Engineering Co., Inc., New York; councilors: Dr. Franklin H. Bivins, chemist with Foster D. Snell, Inc., Brooklyn, and Dr. Donald Price, chief chemist, research laboratory of National Oil Products Co., Harrison, N. J. Dr. Marston L. Hamlin, research and development department of the Barrett Co., New York, was elected as representative of the Chapter to the national council of The American Institute of Chemists.

GOODRICH AND STANDARD OIL (N.J.) ANNOUNCE SYNTHETIC RUBBERS

John L. Collyer, president of the B. F. Goodrich Co., announced on June 5 that his company had begun the manufacture of tires made from a new synthetic rubber-like material—Ameripol. Made of American raw materials and developed by American research, the new material is produced by polymerization; hence the name *Ameri-pol*. Dr. Waldo L. Semon, inventor of Koroseal, was responsible for the 14-year research program resulting in this "Liberty Rubber" that is expected to aid in American preparedness.

Raw materials for Ameripol were said to be butadiene and "other ingredients prepared from natural gas and air." These are emulsified with soap to form a latex which may be coagulated with acid and processed in regular rubber-processing equipment. A pilot plant has been in operation for a year and a half and a full-scale plant with a daily capacity of several tons will be ready for operation this Fall.

One day earlier W. S. Farish, president of Standard Oil Co. (N. J.), announced that a new synthetic product from petroleum had been discovered by Esso Laboratories and called Butyl Rubber. The new product is a companion to Buna, but will not be competitive because, unlike Buna, it is not oil-resistant. However, Butyl is expected to be appreciably lower in cost. A semi-commercial pilot plant is now in operation at Bayway, N. J.

GERMAN CHEMICAL PRODUCTS FEATURED EXHIBITS AT TRADE FAIR HELD IN MILAN

From Our German Correspondent

That the chemical industry is playing a leading role in Germany's drive to export in spite of blockade and war is evidenced by the prominence given to Reich chemical exhibits at the Milan trade fair held from April 17 to 27. The exhibits of 32 German chemical concerns, inspected by over half a million visitors, were the center of the display of the Reich, which was by far the largest foreign exhibitor.

Included in the exhibit were many wartime-developed synthetics of the Reich chemical industry, whose total production last year is estimated to have exceeded 6,000 million RM in value. The whole exhibit was built around products which can be made from Germany's readily available materials, coal, wood, salt, water, and air. In addition to Buna, plastics, and synthetic motor fuels, various new textiles were exhibited, among them nets and ropes made of coal-lime base fibers, and synthetic jute and potato vine fibers. Large displays explained methods of producing synthetic motor fuel, and special emphasis was placed on soaps manufactured from paraffin as a byproduct of the Fischer-Tropsch Ruhrchemie benzine synthesis.

As illustrated, this process starts with a mixture of carbon monoxide and hydrogen in a 1 to 2 ratio. At 200 deg. C. at normal or intermediate pressures, this gas mixture is conducted over solid catalysts to be transformed into liquid and solid hydro-carbons. These range from methane, propane, butane, etc., to paraffin, and are separated from the end gas by cooling and absorption to be processed further as desired. The synthesis proceeds from pure water gas, from which sulphur has been removed, so that the end product is the same whether the gas comes from coke, lignite, or other material. The Ruhrchemie synthesis claims to produce good quality table paraffin as well as a hard paraffin wax of high melting point. Through oxidation of the paraffin, fatty acids and soaps can be produced. A variation of the synthesis permits the production of higher aliphatic alcohols of every possible C-atomic number, as well as the corresponding fatty acids and esters.

I. G. Farben also exhibited new textile soaps in which washing efficiency has been increased several-fold for the amount of fat used. Also displayed were the purely synthetic detergent "Igepal," produced since 1934, and the latest fat-free washing soap developed by I. G. from coal in 1939. It seems, however, that where possible some natural fats are left for soaps used by humans, with the fat-free soaps being used principally for washing textiles.

It is expected that additional wartime products will be shown in the exposition entitled "Raw Materials and Chemistry" to be staged in Breslau, Germany, July 28 to August 4 by "Dechema," the German Association for Chemical Apparatus. The autumn trade fairs of Leipzig and Cologne, beginning August 25 and Sept. 29, respectively, also will feature chemical exhibits.

An ambitious project for coordinating research and scientific organization headquarters is the new "House of German Research" opened recently in Berlin-Dahlem. It is projected in time to unite under one roof all institutions, societies, and organizations in the Reich whose purpose and interest is science and research. The German Research Association was the first to move into the new quarters.

The Kaiser Wilhelm Institute in Berlin-Dahlem reports that it has developed a new atom smasher capable of reducing atoms to electrons and neutrons by the application of 3,200,000 volts D.C. At the University of Leipzig a new cyclotron is also being installed. The first of its kind in Germany, the apparatus produces alpha rays artificially by means of electro magnetism and reaches 11 to 16 million electron volts in the process.

Siemens & Halske, electric concern, has established a super-microscope laboratory where members of scientific institutes and industrial organizations are being trained in the handling of electron microscopes. Developed by Dr. E. Ruska and associates, the new microscope, having no lenses and using electrons instead of light waves, permits 100,000-fold enlargements and has made it possible to photograph molecules and heretofore invisible viruses. Recently the Siemen's Reiniger works began the installation of what is claimed to be the world's largest X-ray apparatus in the Roentgen Institute of the Hamberg-Barnbeck hospital. The 1,200,000 volt Roentgen therapy apparatus, standing over 21 feet high, is to be used for cancer treatment, and the effect of its rays is claimed to equal that of 20 pounds of radium.

The Nurnberg plant of the Siemens-Schuckert works recently announced completion of what is claimed to be the world's largest all-automatic welding machine. It weighs 75 tons and is 24.5 ft. long, 10 ft. wide, and 20 ft. high. The welding process, which can be applied to flat material as well as to pipes, angles, and flanges, is set in motion by the simple pushing of a button.

Not far from the central German lignite fields are the newly developed iron ore districts. Here during the first half of May eight additional blast furnaces were put into operation. With

improved smelting processes and treating ore of an iron content claimed to be 40 per cent higher than originally estimated, this source of domestic iron supply is being developed energetically in order to keep the Nazi war machine and economy moving.

The problem of consolidating military-held areas strategically and economically is becoming increasingly complex as the war goes on. German-held Scandinavian and Dutch and Belgian areas all present a somewhat similar problem. While providing the Reich temporarily with additional reserves and food supplies (and cutting off Britain from important food supplies heretofore obtained from these countries), they also include industries which have been largely dependent upon foreign raw materials and foreign markets as sales outlets. If the Reich, for example, can secure fodder from the Balkans for the dairying industries of the captured areas, Germany's food supply, especially of butter and fats, will be considerably bolstered.

An incidental result of the occupation of the Netherlands of significance in Balkan trade is that on May 18 the Continental Motorship Co. of Amsterdam, which operates Netherlands shipping on the Danube, transferred its fleet to German registry. This additional tonnage brings Danube shipping preponderantly under German control and will make shipments from the Balkans easier for the Nazis. When the Rhine-Main-Danube canal is completed, this should give the Reich additional strategic and economic advantages.

In the Polish-held sections, an organization, the "Handels-aufbau Ost G.m.b.H.," was recently established to develop commerce. This large concern which already has branches in Danzig, Posen and Kattowitz, plans to open further branches later in Lodz, Bromberg, Thorn, and Graudenz.

In the Polish provinces it is estimated that 37 million acres of waste land can be reclaimed and made available for agriculture. In the Old Reich in the last six years at a cost of 1,500 million RM, 5,700,000 acres of former swamp and waste land have been reclaimed and are now under cultivation. The addition of this arable land is all the more important because it will have to help supplant agricultural land lost by reason of its use for automobile highways, fortifications, air fields, etc.

"Blackouts" and accompanying inconveniences have resulted in the development of a new luminous paint consisting of synthetic tar products and purely organic pigments. Objects treated with the new "Lumogen-L" paint developed by Reich chemists shine brightly in the dark under the influence of ultra violet rays produced through a mercury lamp or an ordinary light bulb in a special black glass piston. A kilogram of the new substance can be manufactured for less than one RM and can be mixed with resin, gum, wax, or other substances, without losing its luminous quality, and can be applied indoors as well as outdoors.

PRODUCTION AND SALES OF SYNTHETIC ORGANIC CHEMICALS MADE NEW RECORD LAST YEAR

The U. S. Traffic Tariff Commission has issued preliminary statistics of production and sales of synthetic organic chemicals in 1939. The data cover production and sales of coal-tar intermediates, coal-tar dyes, other finished coal-tar products, and non-coal-tar synthetic organic chemicals.

Sales of all synthetic organic chemicals in 1939 were valued at $381,917,000, not only exceeding by 38 per cent those in 1938, but also exceeding those in any preceding year. The increase in coal-tar chemicals was 41 per cent, or from $130,462,000 in 1938 to $183,355,000 in 1939, and in non-coal-tar synthetic organic chemicals 36 per cent, or from $146,435,000 in 1938 to $198,562,000 in 1939. The groups that advanced the most in sales value were intermediates, medicinals, and synthetic resins. This peak activity in synthetic organic chemicals in 1939 resulted from improved business conditions, a building up of inventories by both producers and consumers, and increased exports in the last quarter, particularly to countries whose imports of synthetic chemicals previously came chiefly from the European belligerents. Although all synthetic organic chemicals cannot be segregated from other products in official export statistics to give a group total, it is known that exports of these synthetic products advanced considerably in 1939. The value of exports of all coal-tar chemicals was $9.891,000 in 1938 and $14,612,000 in 1939.

In 1939, as in preceding years, a substantial part of the output of synthetic organic chemicals was consumed by producers in further processing. More than half of the coal-tar intermediates and of non-coal-tar chemicals, as well as smaller fractions of some of the other groups, was consumed by the producing companies.

The synthetic organic chemical industry employed 2,197 technically trained research workers, at an average salary of $3,113. The total cost of research was $13,064,000, or 3.4 per cent of sales of all products.

Production of 605,757,000 lb. of coal-tar intermediates was 50 per cent greater than the output in 1938 and established a new high, exceeding by 30,000,000 lb. the former peak output in 1937. Sales, by quantity, were up 56 per cent. The production of intermediates used in the manufacture of synthetic resins increased more than did the total production of intermediates; the output of phthalic anhydride and phenol increased 60 per cent and 54 per cent, respectively. The production of practically all intermediate chemicals for use in dyes was considerably above that in 1938; the output of 41,775,000 lb. of the basic commodity, aniline oil, was a 56 per cent increase.

Production and Sales of Certain Synthetic Chemical Products, 1939

	Production lb.	Sales lb.	Sales Value	Unit value
Coal-tar: Total	**68,695,986**	**55,278,222**	**$12,475,923**	**$0.23**
Photographic chemicals: Total	2,121,041	1,716,241	1,847,694	1.08
Hydroquinone[1]	1,[illegible]41,329	1,389,022	1,339,880	.82
Methyl p-aminophenol sulfate (metol) (rhodol)	275,186	290,537	636,219	2.19
Plasticizers: Total	23,839,211	19,299,337	4,089,378	.21
Phthalates: Total	15,753,079	11,334,218	2,227,078	.20
Dibutyl	7,923,771	5,661,733	942,134	.17
Diethyl	1,812,925	1,373,457	240,072	.17
Textile chemicals: Total	9,452,163	9,045,103	1,969,284	.22
Non-coal-tar: Total	**2,946,150,750**	**1,447,999,107**	**171,597,844**	**.12**
Acetic acid (100% purity)	119,652,650	....	....	.....
Acetic anhydride (from all sources) (100% purity)	181,156,152	....	....	.....
Acetone	....	100,935,422	4,384,757	.04
Amines (mono, di, tri)	1,487,643	1,399,353	753,710	.54
Butyl acetates, total (90% purity)	77,734,214	68,158,368	4,690,362	.07
Buty alcohols, total (100% purity)	127,010,364	52,590,016	3,548,824	.07
Normal	72,736,886	45,836,362	3,182,229	.07
Carbon tetrachloride	90,535,580	84,023,750	3,284,664	.04
Choloroform (tech. and USP)	2,933,322	....	....	.....
Citric acid, refined (fermentation)	13,440,323	11,652,711	2,420,986	.21
Diacetone alcohol	3,220,729	2,393,125	187,616	.08
Ethyl acetate (85% purity)	67,897,408	51,622,492	2,706,497	.05
Gallic acid, tech	145,338	....	....	.....
Isopropyl alcohol (isopropanol)	179,062,266	18,407,564	816,373	.04
Lactic acid:				
Edible (100% purity)	1,609,094	1,280,235	270,327	.21
Technical (100% purity)	1,530,456	1,439,401	168,572	.12
Methanol (synthetic)	....	136,407,086	4,836,639	.04
Methyl chloride (chloromethane) (100% purity)	3,021,078	2,947,513	981,926	.33
Oxalic acid	10,416,269	11,854,176	1,168,369	.10
Plasticizers, total	6,031,548	5,069,738	1,674,049	.33
Dibutyl tartate	23,354	23,197	10,197	.44
Pyrogallic acid (pyrogallol)[1]	49,770	60,807	84,955	1.40
Sulfated fatty alcohols, acids, etc. (gardinols, igepons, intramines)	12,527,302	10,660,181	3,037,975	.28

[1] Photographic grade only.

Production of coal-tar dyes amounted to 120,190,000 lb., which represents an increase of 47 per cent over the preceding year. Sales were 30 per cent by quantity and 32 per cent by value more than in 1938. A substantial part of dye sales in 1938 was from inventory. Accordingly in 1939 production increased much more than did sales. A decided betterment in export trade, particularly during the last quarter, contributed to the improvement in sales. Sales of synthetic indigo decreased somewhat in value and increased only slightly in quantity, from 11,738,000 lb. in 1938 to 11,950,000 lb. in 1939. The average value per pound of all dyes sold increased from $0.60 to $0.61. A continuation of the trend toward a greater production of the higher priced dyes more than offset a one cent per pound reduction on synthetic indigo and decreased unit values in the groups of acetate silk dyes and azoic dyes.

Total production of synthetic resins was considerably more than in any preceding year. The 179,338,000 lb. of coal-tar origin exceeded by 67 per cent the output in 1938. Alkyd resins were up 87 per cent and tar acid resins 58 per cent. The output of 33,690,000 lb. of non-coal-tar resins was 44 per cent more than in 1938. The rapid expansion in use of urea resins for surface coatings resulted in an increase in their production of more than 100 per cent. An increase of several fold in sales of the high-priced vinyl acetyl resins, for safety glass manufacture, resulted in a change in the average unit value of sales of non-coal-tar resins from $0.41 in 1938 to $0.46 in 1939. The average value per pound of sales of urea resins decreased from $0.44 to $0.36 during the year.

Production and sales of Synthetic Organic Chemicals

(Production and sales in thousands of pounds; sales value in thousands of dollars.)

	1938	1939
Coal-tar chemicals		
Intermediates:		
Production	401,943	605,757
Sales	171,514	267,705
Sales value	26,090	38,122
Finished coal-tar products:[1]		
Production	276,387	434,606
Sales	245,340	351,024
Sales value	104,372	145,233
Dyes:		
Production	81,759	120,190
Sales	87,803	114,494
Sales value	53,096	70,223
Medicinals:		
Production	11,097	13,910
Sales	8,885	12,311
Sales value	9,509	13,496
Flavors and perfume materials:		
Production	3,837	4,352
Sales	3,664	3,979
Sales value	3,368	4,144
Coal-tar resins:		
Production	106,923	179,338
Sales	84,764	128,420
Sales value	15,811	23,028
Non-coal-tar chemicals:		
Production	2,409,456	2,996,545
Sales	1,121,608	1,498,309
Sales value	[2]146,435	198,562

[1] Includes color lakes, rubber chemicals and miscellaneous coal-tar products not shown separately.

[2] Adjusted so as to be on the same value basis as 1939.

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PRODUCTS OF UNIFORM SUPERIOR PERFORMANCE

PERSONALITIES

H. E. Thompson

Harry L. Fisher

✦ H. E. THOMPSON, vice president and chief engineer of Carbide & Carbon Chemicals Corp., received an honorary doctor of science degree from the University of W. Va., June 8.

✦ HARRY L. FISHER, research laboratory, U. S. Industrial Alcohol Co., Stamford, Conn., was elected president of the American Institute of Chemists. William T. Read, dean, school of chemistry, Rutgers University, was elected vice president.

✦ C. L. BARRETT, formerly general sales manager of the Pomona Pump Co., has been elected to the office of vice president in charge of sales. W. D. Turnbull has been made general sales manager in charge of the New York office.

✦ GERALD E. STEDMAN has been appointed sales manager, Rego Division, and Ellsworth L. Mills has been made vice president in charge of sales of the Bastian-Blessing Co.

✦ OLIVER F. BENZ has resigned as director of sales of the Cellophane Division, E. I. duPont de Nemours & Co., Inc. He has been in charge of sales for Cellophane cellulose film since 1924 when American manufacture of this product was started by du Pont. Clarence F. Brown will succeed Mr. Benz, as director of sales.

✦ M. E. CLARK, assistant editor of *Chem. & Met.* has been elected president of the Junior Chemical Engineers of New York City. The other officers are: R. P. Devoluy, American Cyanamid Co., vice president; H. Ten Broeck, Socony-Vacuum Oil Co., secretary; and F. B. Weiss, Foster-Wheeler Corp., treasurer.

✦ RICHARD L. TEMPLIN, chief engineer of tests, Aluminum Company of America, was awarded an Edward Longstreth medal by the Franklin Institute in recognition of his invention of a deformation recording apparatus.

✦ ROBERT E. MITCHELL, formerly associated with the Joseph Dixon Crucible Co. as manager of paint sales, is now president of the newly organized corporation, Paint Engineers, Inc., Hawthorne, N. J.

✦ PAUL F. BRUINS, has been promoted from instructor to assistant professor of chemical engineering at Polytechnic Institute, Brooklyn, N. Y. Willet F. Whitmore, has been promoted from associate professor to professor of organic chemistry. Clarence B. F. Young has changed from lecturer in electrometallurgy in the graduate school to adjunct professor of chemical engineering.

✦ CLAUDE F. DAVIS, chief chemist for Noblesville Milling Co., Noblesville, Ind., was elected president of the American Association of Cereal Chemists at its recent annual meeting. Charles N. Frey, head of the research laboratories, Standard Brands, Inc., New York, was elected vice president.

✦ FREDERICK G. STAMM has been appointed to head a newly organized paper mill division of the Armstrong Machine Works, Three Rivers, Mich.

✦ HOWARD A. SMITH, until recently research metallurgist with Rustless Iron & Steel Co., Baltimore, Md., and previously in charge of stainless steel developments in the laboratories of Republic Steel Co., Canton, Ohio, has been made chief metallurgist of the Duraloy Co., Scottdale, Pa.

✦ H. D. ELLIS has been elected president of Wilson & Bennett Mfg. Co., succeeding Wilfred Sykes. Mr. Sykes remains chairman of the board.

✦ S. W. GIBB has been promoted to the position of general sales manager of the Philadelphia division, The Yale & Towne Mfg. Co. He succeeds James C. Morgan who stepped up to the post of general manager of all Philadelphia operations.

✦ ALBERT KELLNER, export manager of The Porcelain Enamel & Mfg. Co., Baltimore, has returned to the home office of Pemco after an extended business trip to South America.

✦ WILLIAM TAGGART has been appointed manager of tube sales for the Timken Roller Bearing Co.

✦ W. B. COULLIE, formerly assistant to the president and general sales manager, has been elected vice president of Harbison-Walker Refractories Co. H.

CALENDAR

JUNE 24-28, American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City.

AUG. 20-23, Technical Association of the Pulp & Paper Industry, fall meeting, Olympic Hotel, Seattle, Wash.

SEPT. 9-13, American Chemical Society, fall meeting, Detroit, Mich.

OCT. 2-5, Electrochemical Society, fall meeting, Ottawa, Canada.

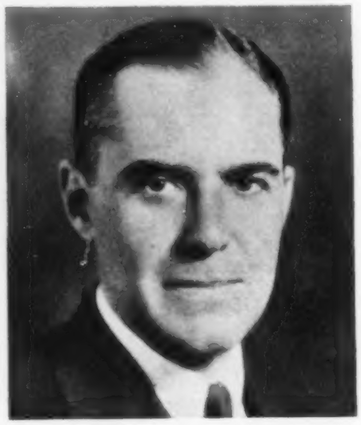
OCT. 7-10, American Gas Association, Atlantic City.

DEC., American Institute of Chemical Engineers, New Orleans, La.

DEC. 11-15, National Chemical Exposition, Chicago, Ill.

S. Robertson, formerly assistant general sales manager, has been appointed general sales manager.

✦ HAROLD BOESCHENSTEIN, president of the Owens-Corning Fiberglas Corp. of Newark and Toledo, Ohio, has been chosen an outstanding alumnus of the College of Commerce and Business Administration of the University of Illinois. He has been president of the Fiberglas corporation since its formation on Nov. 1, 1938.



Harold Boeschenstein

✦ PAUL N. ROBINS has been elected vice president and treasurer of Greene, Tweed & Co.

✦ CHARLES G. MCCABE has been added to the technical staff of the Battelle Memorial Institute, Columbus, Ohio. He is to assist in work being undertaken at Battelle on the chemistry of the open-hearth steel process.

✦ STEWART E. LAUER, president of the York Ice Machinery Corp., was elected president of the Air Conditioning Manufacturers' Association during the recent meeting at Hot Springs, Va.

✦ MICHAEL S. SHENK is now located at the headquarters of the Claremont Laboratories, New York City.

✦ R. T. YATES has been appointed manager of domestic sales of the naval stores department of the Hercules Powder Co. D. M. Houston has been appointed manager of naval stores export sales. Mr. Yates joined Hercules in 1929 as a member of the experiment station staff at Kenvil, N. J. and came to Wilmington in 1930 as a member of the naval stores department sales force. Mr. Houston became associated with Hercules Experiment Station at Kenvil in 1924. He was appointed to the staff of the Union plant at Parlin in 1925 and in 1928 went to Wilmington as a member of the cellulose products department.

✦ H. S. WHERRETT, president of the Pittsburgh Plate Glass Co., has been

elected president of the Columbia Alkali Corp., a subsidiary, succeeding Hugh A. Galt, who retired recently.

✦C. B. Boyne has been appointed manager of stainless sales for the Allegheny-Ludlum Steel Corp. with headquarters in the general office of the corporation at Pittsburgh.

✦ William C. Schoenfeld, a graduate of Brooklyn Polytechnic Institute, has been added to the staff of Foster D. Snell, Inc.

✦ Lincoln T. Work of the chemical engineering department at Columbia University, has been elected chairman of the American Section of the Society of Chemical Industry. Foster Dee Snell has been elected vice chairman. Cyril S. Kimball and J. W. H. Randall were re-elected honorary secretary and honorary treasurer, respectively.

✦ O. P. Robinson has been appointed to Cutler-Hammer's Pittsburgh sales engineering staff.

R. K. Turner

✦ R. K. Turner, assistant superintendent at the South Charleston plant of Carbide and Carbon Chemicals Corp., will succeed R. N. Graham as superintendent. Mr. Graham will join the staff organization at headquarters in New York as assistant works manager. Mr. Turner, a graduate of Massachusetts Institute of Technology, has been on the staff of the South Charleston plant since it went into operation in 1925.

✦ D. B. Benedict will become assistant superintendent of the South Charleston, W. Va. plant of the Carbide and Carbon Chemicals Corp.

✦ H. M. Ross has been selected to be superintendent of the Texas City, Tex. plant of the Carbide and Carbon Chemicals Corp. E. D. Fox and D. B. King will be assistant superintendents at the new plant when it is completed. These three men are now on the staff of the South Charleston, W. Va. plant of the company.

✦ WILLIAM H. BRADSHAW, director of viscose rayon research for E. I. du Pont de Nemours & Co., received the Jacob F. Schoellkopf Medal for 1940. The medal is awarded by the Western New York Section of the A. C. S. He is a native of De Kalb, Ill., a graduate of Beloit College and the Massachusetts Institute of Technology.

Edward E. Marbaker

✦ EDWARD E. MARBAKER has been appointed to the incumbency of the industrial fellowship founded by O. Hommel Co. at the Mellon Institute. For 20 years he has been a fellow at the Institute.

OBITUARY

✦ WILLIAM H. QUINN, New York district manager of Chain Belt Co. of Milwaukee, died suddenly May 5 in New York City. He had been with the company since 1923 and manager of the New York office since 1928.

✦ LEWIS VAN CARPENTER, professor of sanitary engineering in the New York University College of Engineering and a director of the Sanitary Engineering Research Laboratory, died of heart disease. He was 45 years old.

✦ MAX F. WIRTZ, founder and president of the Atlas Mineral Products Co. at Mertztown, Pa., died after a lengthy illness, May 9, at his home in Allentown. He was in his 71st year and had recently returned from a business trip to San Francisco. Later he underwent treatment at a Philadelphia hospital.

✦ OTTO H. FALK, chairman of the board, Allis-Chalmers Mfg. Co., passed away May 21. General Falk was 74 years of age. He was taken ill last Fall of a heart ailment and had been bedridden since November. During his sickness he had several relapses but his powerful physique held out against the setbacks. However, recently his condition took a turn for the worse.

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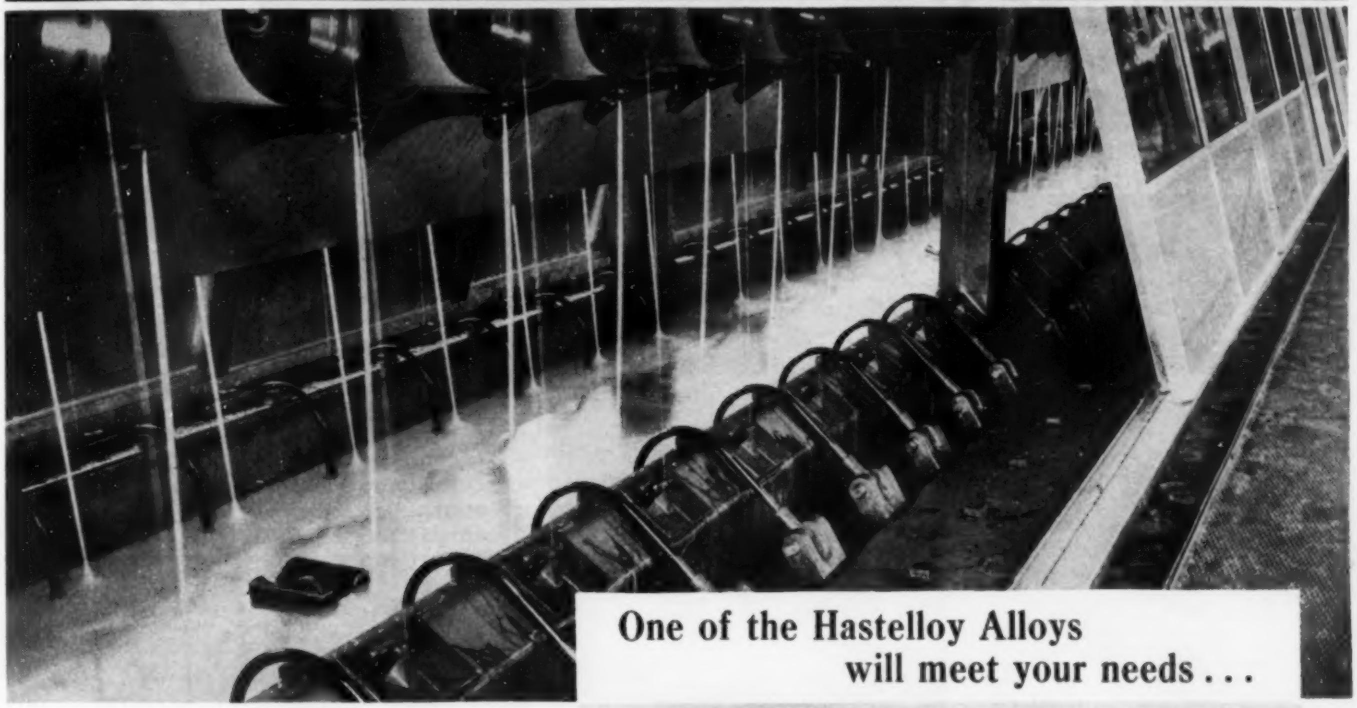

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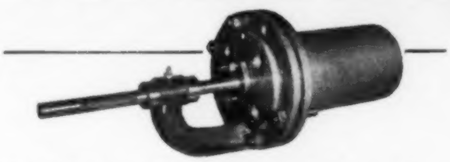
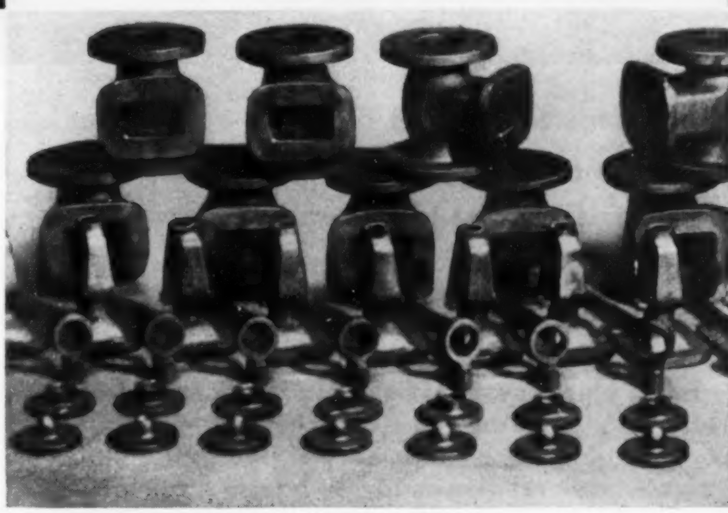


This 5¼-in. O.D. by 10⅛-in. long autoclave is made of Hastelloy alloy B for a pilot plant making a corrosive medium. The steel cover assembly is lined with Hastelloy alloy B. The unit was tested at 90 pounds hydrostatic pressure before shipping.



This cylinder liner, 10 in. in diam. at the large end, is made of Hastelloy alloy D for use in a sulphuric acid sludge pump. The liner was finished by grinding.

• • •

Write for "Hastelloy High-Strength Alloys for Corrosion Resistance" and samples of the four Hastelloy alloys for test in your plant. Address Kokomo, Indiana or the nearest district office — Chicago, Cleveland, Detroit, Houston, Los Angeles, New York, San Francisco, Tulsa.

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THE Hastelloy alloys–A, B, C, and D–combine excellent resistance to severe corrosion with high strength. Each alloy is designed for a specific service–A for hydrochloric acid; B for boiling hydrochloric acid; C for free chlorine; D for sulphuric acid, hot or cold–but final selection is usually based on tests of all four alloys under actual operating conditions. Illustrated on this page are typical parts made of the Hastelloy alloys. Hastelloy alloy A fittings are used on the mass tubes and clevis blocks in the rayon producing unit shown at the top of the page while Hastelloy alloy C is used for the gate valve parts shown above, for handling coal tar derivatives.

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High-strength nickel-base alloys for corrosion resistance.

HAYNES STELLITE COMPANY

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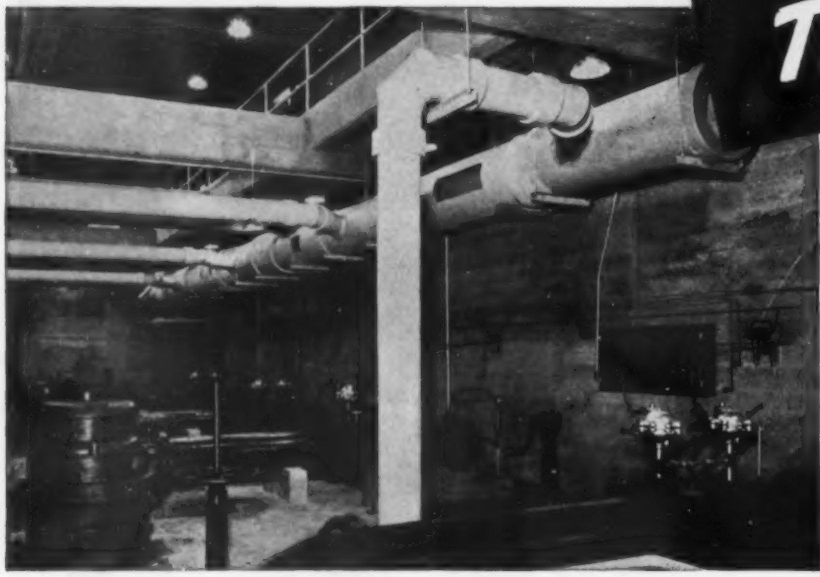
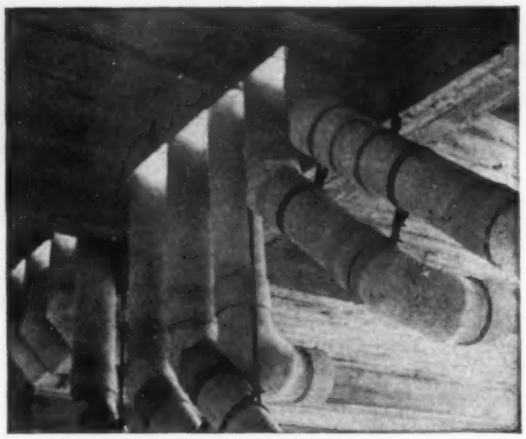


SEWAGE-PLANT GASES have little effect on Transite "S" Pipe. Made of asbestos and cement, this durable material is highly resistant to all forms of corrosion. This installation is in the Des Moines, Iowa, Sewage-Disposal Plant.



LABORATORY FUMES have been carried in this Transite "S" Pipe system for the past 2 years. The wide range of fittings available makes possible rapid installation even in cramped working quarters.

Time after time, J-M Transite "S" Pipe has proved its ability to add longer life and lower maintenance to industrial venting systems

IN SCORES of plants all over the country, J-M Transite "S" Pipe is setting new standards for venting efficiency and long life. And for good reasons. An asbestos-cement product, this material is custom-made for industrial venting. Uniformly strong and durable, it is highly resistant to most commonly vented fumes, gases, vapors and dust.

But that's not the whole story. Transite "S" Pipe is supplied in long, 13-foot lengths, with a complete line of fittings. It can be readily cut or sawed with ordinary tools . . . easily adapted to any structural needs. Even in restricted working areas, jobs are finished quickly at low cost. For full details, write for brochure DS-336. Johns-Manville, 22 East 40th Street, New York, N. Y.

WEATHER ON THE OUTSIDE, corrosive salt fumes on the inside, make a tough combination. Yet these Transite Ventilators and Transite "S" Pipe lines at the Hutchinson, Kansas, plant of the Morton Salt Co. are virtually unaffected.

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TRANSITE "S" PIPE

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New Titles, Editions and Authors

Chem & Met BOOKSHELF

Printing Inks. By *Carleton Ellis*. Published by Reinhold Publishing Corp., New York, N. Y. 560 pages. Price $7.

IN THE PAST few years synthetic resins have been used in continually increasing amounts in the manufacture of printing inks. It was, therefore, natural that one of the country's authorities on these resins should turn his attention to printing inks. When he discovered no book giving adequate treatment of the subject, he decided to write one. And examination of the product of his efforts reveals a thorough and complete job.

After two introductory chapters which give a brief history of printing and necessary background descriptions of presses and processes, the book continues with chapters on vehicles, driers, modifiers and pigments. Different types of inks; typographic, planographic, intaglio, transfer, emulsion and special purpose types all have complete descriptions and discussions. Numerous formulas, analyses of inks and directions for use are scattered throughout the text. The book concludes with chapters on problems encountered, testing and paper. A nine-page glossary of terms and 64 pages of subject and author indexes add to the value of the book. Nearly every page of text has several footnotes; these total more than 2,300 sources of additional or specialized information.

Usable information is the keynote of this book. Ink manufacturers, printers, lithographers, photoengravers, chemists, paper makers and even editors—all who are directly or indirectly concerned with printing ink will find something of interest and value in this volume which takes its place beside the author's two other treatises "The Chemistry of Synthetic Resins" and "Chemistry of Petroleum Derivatives."

PLASTICS

Plastics in Engineering. By *J. Delmonte*. Published by Penton Publishing Co., Cleveland, Ohio. 616 pages. Price $7.50.

Reviewed by *J. A. Lee*.

THE PLASTICS INDUSTRY, in all of its phases, has developed so rapidly that there has not been sufficient time for most engineers possessing the knowledge, even though they might have been so inclined, to undertake to write a book on the subject. As a result our library of books dealing with these new and extremely interesting materials is limited to a mere handful of volumes. Each newcomer is a welcomed addition.

The authors of our previously published books have been content to limit their coverage to a few phases of the subject of plastics but Mr. Delmonte has been more ambitious and has sought to discuss all but the production of the resins. In fact, he has even gone outside of the generally accepted boundary of the industry and included a chapter on synthetic rubbers.

While the omission of the resin manufacturing procedure detracts from its value to chemical engineers nevertheless it contains other worthwhile information. Furthermore, the very fact that it is a new book in a field that is changing at a rate that makes obsolete a publication of a year or two ago, recommends it to any one interested in plastics.

Physical Constants of Hydrocarbons. Volume II. By *Gustav Egloff*. Published by Reinhold Publishing Corp., New York, N. Y. 605 pages. Price $12.

CYCLANES, cyclenes, cyclynes and other alicyclic hydrocarbons are covered in this second volume of a projected four-volume series. The presentation follows the style set by the first volume (see *Chem. & Met.* p. 374, June, 1939). One introductory chapter contains a discussion of theoretical considerations of structural configuration and also a complete description of the rules used in naming the compounds. Each subsequent chapter is devoted to a particular family of compounds. Data given are melting and boiling points, refractive indexes and specific gravities.

Pure alicyclic compounds are often difficult to prepare and many are mixed with geometrical isomers, so reported constants do not always agree. The alicyclic compounds are, as a rule, less important industrially than the aliphatic. These two considerations explain any discrepancies and gaps in the present volume. A section on critical evaluation, given in chapter I, will extend the usefulness of the data presented in the remaining chapters. And a generous amount of space has been allowed for the insertion of new data as they become available.

Manual of Industrial Health Hazards. By *J. B. Ficklen*. Published by Service To Industry, West Hartford, Conn. 176 pages. Price $4.

IN THE matter of safety, it is sound business policy to protect the workers. And in order to do this is it necessary to know the hazards to which they are exposed. In this book, a well known chemical engineer presents methods for evaluation of industrial hygiene exposures resulting from many gases, fumes, vapors and dusts. The first of the book's 63 chapters contains notes on air sampling and each subsequent chapter is devoted to a particular material or family of materials. Occurrence, uses and physical properties are given for each material as well as physiological effects, allowable concentrations and a simple test method.

PHYSICAL CHEMISTRY

Physico-Chemical Methods. Second edition. By *J. Riley* and *W. N. Rae*. Published by D. Van Nostrand Co., Inc., New York, N. Y. Two volumes, total of 1266 pages. Price $17.50.

Reviewed by *D. F. Othmer*

HERE we have much that is of value to the chemical engineer because the background of his profession is physical chemistry. The present edition of this book (mainly on experimental methods), enlarged over 50 per cent above the second edition, includes some 850 illustrations, mostly line drawings although some of them might be classified as freehand sketches. It leans on the cooperation of several other specialists in various fields and has, as an important addition, an ample list of "Suggestions for Further Reading."

This edition has been considerably improved by taking into more account the contributions of chemical engineers to the field of experimental physical chemistry, because in so many cases chemical engineers have necessarily had to obtain data and devise equipment properly belonging to the field of the physical chemist since the nature of the engineer's work oftentimes seems somewhat too practical for the physical chemist. Thus the chapter on laboratory distillation has been rewritten from this standpoint and much more of the technique of the past, when distillation was a chemical rather than an engineering problem, might have been eliminated with advantage.

One would expect from this book—its name, preface, etc.—that he was to find a compendium of laboratory methods in physical chemistry (and physics since the authors seem concerned with the borderline between those two sciences). Thus the preface states "Results of theory are envisaged only on the experimental or men-

surational side." One is likely to find almost anything (and "find" is certainly the word, meaning the result of search, since for the more than 1250 pages including thousands of topics there is an index of less than two full pages). While most of the subject matter is valuable and useful, it is certainly not a balanced presentation of laboratory technique as one has been lead to expect. The theoretical treatment to which considerable attention is given at times is not only repetitious within the volume itself, but also of the many other textbooks of physical chemistry, any one or several of which will be on the desk of the worker having access to such a specialized book as this. This is at the expense of the laboratory operations which should be covered. Examples to show this point are many. Thus, in the field of latent heat, certainly a physical chemical determination of much interest to the chemical engineer and one deserving of careful description of methods, apparatus, corrections, and so forth, in a treatise of this type, there are only three pages of which almost two are devoted to the derivation of the Clapeyron and other basic equations relating to latent heat (which derivations are, of course, available in any elementary book on physical chemistry or thermodynamics). Only six lines are devoted to the discussion of the theory and practice of determining latent heat of vaporization in general and one page to the very special case of the determination of the latent heat of vaporization of ethyl ether (or carbon disulphide) which reads strangely as though it were a verbatim copy of an experiment sheet for the undergraduate physical chemistry laboratory. Yet there is room for eight pages on the history and theory of accumulators (storage batteries) which most laboratory workers are willing to take entirely for granted and use as they do a motor, a hammer or any other tool; also some nine pages on elementary photography which, since it covers the whole field of this tremendous science and art including construction of cameras, negative and positive materials, enlargements, and so forth, must do so in such general terms that they are almost valueless to any advanced worker using photography as a tool in his science.

One finds what he finds, and sometimes most accidentally. Thus, for example, there is a discussion of full plant size evaporators, dryers, filters, Dorr classifiers, hydraulic classifiers, trommels, grizzlys and magnetic separators (discussed under Flotation). These descriptions are not from the standpoint of their theory or physical chemical methods but from the standpoint of mechanical details of construction. A chemical engineer will feel that such things have been presented much better in Perry or in textbooks of chemical engineering and the entirely descriptive treatment given here might better be omitted. On the other hand, one might think that

a physico-chemical method applied to the field of drying would include some discussion of the experimental determination of humidity and other similar factors relating to drying. The reviewer has, however, been unable to find any such discussion of methods for determination of humidity in air mixtures even though there is a reprinting of the standard techniques for ordinary gas analysis.

Occasionally, there seems to be more interest in presenting data itself rather than the method of obtaining such data and, for example, instead of a discussion of the theory and method of obtaining liquid-vapor equilibrium curves with illustrations of such methods as have been devised and standardized, the only cut is of the data plotted for a particular mixture. For some reason fugacity is defined under this heading. The separation of gases by a solvent is described only by relation to the plant scale operation that chemical engineers refer to as gas absorption rather than any methods adaptable to the physical chemical laboratory.

Scattered through the text there are minor mistakes as, for example, the reference to the extraction of dilute acetic acid with toluene, a material which has a very poor partition coefficient for such separation, and mention of a patent by Reilly and Blair as U. S. Patent 21475/1925. All in all, however, while this book might be reduced to half its present size and still accomplish its desired purpose, it is by far the best compendium which is available on this subject and the extraneous matter is oftentimes of considerable value and remarkably well presented. It should be on the shelf of those interested in the use of physical chemistry methods in design and operation.

TEXTS AND REFERENCES

CHAPTERS IN THE CHEMISTRY OF THE LESS FAMILIAR ELEMENTS. By *B. S. Hopkins.* Published by Stipes Publishing Co., Champaign, Ill. 494 pages. Price $5.

ACCORDING to the publisher, this book has been so anxiously awaited by some colleges and industrial firms that individual chapters have been bought as fast as they become available. An examination of the finished product reveals its probable value to all interested in those elements not commonly encountered. There are 22 chapters, all with extensive lists of references, giving all the latest available information on nearly 40 elements. Among those discussed are Li, Cs, Be, Ce, Th, Ti, V, Se, Rh, Pd, Os, Ir, A and Kr.

PHYSICAL ORGANIC CHEMISTRY. By *L. P. Hammett.* Published by McGraw-Hill Book Co., New York, N. Y. 404 pages. Price $4.

FIRST of its kind in the field, this book is an attempt to bridge the gap on the borderline between organic chemistry and physical chemistry be-

tween which, until now, there were only scattered literature references. It seems improbable that this masterful job will recruit a large audience from the ranks of chemical engineers; they don't have time to study carbonium ions, carbon suboxide and other interesting but remote subjects—more's the pity. For those whose activities do lie in the organic field, the studies of reaction rates and mechanisms, stereochemistry of the displacement reaction, effect of structure on reactivity and Prof. Hammett's other chapters may prove to be the key to unlock many a knotty problem.

PROCEEDINGS OF THE FORTY-SECOND ANNUAL MEETING. Published by the American Society for Testing Materials, Philadelphia, Pa. 1344 pages. Price $8.50 (paper), $9 (cloth), $10 (half-leather).

IN LINE with a new policy, both Committee Reports and Technical Papers have been published in one volume. Tentative standards, formerly published in the Proceedings, are now included in the 1939 book of Standards.

The Society's important annual recommendations on specifications and standard test methods for materials are included in the committee reports section of this volume. The technical papers section, preceded by Prof. H. F. Moore's Edgar Marburg Lecture, contains 20 papers dealing with metals, 16 papers discussing cement, concrete and masonry materials, eight covering shear testing of soils and 15 papers for miscellaneous materials and subjects. As usual, the book contains the latest authoritative information on hundreds of different materials.

THE CHEMISTS' YEAR BOOK. Revised Edition. Edited by *E. Hope*. Published by the Chemical Publishing Co., New York, N. Y. 1257 pages. Price $6.

COVERING approximately the same material as the familiar Handbook of Chemistry and Physics and Lange's Handbook of Chemistry, this British counterpart suffers by comparison. It is smaller, 4 x 6 in., and the typography, particularly in the tables, is often inferior. However, the book does contain much valuable material particularly in the fields of bacteriology and biochemistry. Directions for analysis are given for such substances as beer, rum, hops, milk, cream, rice and many others. This type of material is not usually found in handbooks.

QUANTITATIVE ANALYSIS. By *H. S. Booth* and *V. R. Damerell*. Published by McGraw-Hill Book Co., New York, N. Y. 246 pages. Price $2.25.

ELEMENTARY quantitative analysis is an important part of the training of all chemical engineers and although the authors say this is "avowedly an elementary text," it appears to be a good one. Designed for either one or two term courses, it is the outgrowth of a repeatedly revised lithoprinted book. An interesting feature which

should be of value to students is the summary at the beginning of most chapters. It contains a paragraph outlining the most common sources from which errors may enter the results. This forewarning should greatly increase accuracy of results.

AMERICAN GAS ASSOCIATION PROCEEDINGS, 1939. Published by American Gas Association, 420 Lexington Avenue, New York, N. Y. 649 pages. Price $3. to members; $7 to nonmembers.

THIS REPRESENTS the annual printing of all the important technical and economic papers which have been presented to the Association during the past year. In this sense it is more than a simple record of the convention proceedings of October, 1939. It is a volume that should be in the library of every institution or individual who requires complete technical literature on fuels and fuel processing.

VOCATIONAL GUIDANCE

THE CHEMIST AT WORK. By *R. I. Grady, J. W. Chittum* and others. Published by *Journal of Chemical Education*, Easton, Pa. 454 pages. Price $3.

BECAUSE it contains descriptions of the work in some fifty lines of chemical endeavor, a few hours with this book will give the technical worker a broader outlook on the whole profession of chemistry with its activities in fields as different as cosmetics and heavy acids or explosives and biochemical research. Each chapter, covering a particular position or job, was written by a different person and each author was qualified by experience and training to relate the various activities connected with his work. With so many authors, every story reflects a different personality, and most chapters are valuable, interesting and well written but a few lack these qualities. Overemphasis on "I" seems to be the principal difficulty in the latter case, however, careful editing has kept this type of writing at a minimum.

It is of particular interest to note the inclusion of a number of chapters on the opportunities for women in chemistry. No well informed person will deny that there are places for women in the chemical as well as in other lines of endeavor. Unfortunately, one or two of the ladies writing for this section were too much on the defensive and inclined to clamor against "discrimination." They detracted from the effectiveness of their expositions.

Probably the best use to which this little book will be put is the guidance of girls and boys who must make their own plans and decisions concerning a profession. When these young people know something of what the chemists are doing, they can decide whether or not they would be fitted for work along similar lines. Among the authors, such well known names as Snell, Ellis, Sherman, Landis and others compel respect for the opinions expressed.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.

Chemical Price Index. The Bureau of Labor Statistics has prepared a new statistical base for its monthly chemical price index. A list of commodities on which this and related chemical groups are calculated each month is given in the monthly announcement "Average Wholesale Prices and Index Numbers of Individual Commodities, March 1940." That issue also gives the recalculation by months back through 1933 and the annual price index averages for earlier years back to 1926. This unnumbered mimeographed document is available from the Bureau of Labor Statistics, Washington, D. C.

First Annual Report of the Administrator of the Wage and Hour Division. U. S. Department of Labor, for Calendar Year 1939; 20 cents.

Occupational Poisoning in the Viscose Rayon Industry, by Alice Hamilton. Division of Labor Standards, Bulletin No. 34; 15 cents.

Trade Practice Rules. The Federal Trade Commission has just published a book covering the trade practice rules promulgated for 59 industries during the period September 1, 1935 through August 31, 1939. Federal Trade Commission; 30 cents.

Flame Speeds and Energy Considerations for Explosions in a Spherical Bomb, by Ernest F. Fiock et al. National Advisory Committee for Aeronautics, Technical Report 682; 10 cents.

Public Health Regulations. Published in Volume 11 of the Code of Federal Regulations of the United States of America, Having General Applicability and Legal Effect in Force June 1, 1938; $2.25 (Buckram)

Report of the National Academy of Sciences, Fiscal Year 1938-1939. Senate Document No. 139 (76th Congress, 3d Session); 20 cents.

Social Security Pamphlets. Two pamphlets recently issued by Social Security Board intending to explain to employees and employers the functioning and purpose of the law, as follows: "Unemployment Compensation — Some questions and Answers"; "100 Questions and Answers on the New Social Security Program." Available from Social Security Board, Washington, D. C.

Technology, Employment, and Output Per Man in Copper Mining, by Y. S. Leong et al. Works Projects Administration, National Research Project Report No. E-12. Available from Works Projects Administration, 1734 New York Avenue, N. W., Washington, D. C.

Physiological Studies of Jerusalem-Artichoke Tubers with Special Reference to the Rest Period, by Clarence E. Steinbauer. Includes use of chemicals. U. S. Department of Agriculture, Technical Bulletin No. 657; 15 cents.

Cotton-Seed Treatment, by R. J. Haskell and H. D. Barker. Includes use of chemicals. U. S. Department of Agriculture, Leaflet No. 198; 5 cents.

Directory of Organization and Field Activities of the Department of Agriculture: 1939. U. S. Department of Agriculture, Miscellaneous Publication No. 376; 25 cents.

Forest Products Statistics of the Northeastern States. U. S. Department of Agriculture, Statistical Bulletin No. 70; 15 cents.

Foreign Commerce and Navigation of the United States, 1938. The annual statistical report giving details of imports and exports of the United States. Bureau of Foreign & Domestic Commerce; $2.25 (Buckram).

Statistical Abstract of the United States, 1939. Bureau of Foreign and Domestic Commerce; $1.50 (Buckram).

Industry Classifications for the Census of Manufactures, 1939. Bureau of the Census; 15 cents.

Foreign Trade of Latin America. A report in three parts covering (1) the trade of Latin America as a whole; (2) the trade of individual Latin American countries; and (3) Latin American export commodities. Part 1 is now available, Parts 2 and 3 to be released later. U. S. Tariff Commission; processed.

Reference Manual of Latin American Commercial Treaties. U. S. Tariff Commission; processed.

Synthetic Organic Chemicals. Preliminary report on United States production and sales, 1939. U. S. Tariff Commission; mimeographed.

List of Respiratory Protective Devices. A Fifth Supplement to Information Circular 7030 has just been issued. U. S. Bureau of Mines; mimeographed.

List of Permissible Mine Equipment Approved to January 1, 1940, by L. C. Ilsley. U. S. Bureau of Mines, Information Circular 7110; mimeographed.

Electrolytic Method for the Production of Calcium Boride, by J. Koster, R. G. Knickerbocker, and A. L. Fox. U. S. Bureau of Mines, Report of Investigations 3500; mimeographed.

New Metallurgical Experiment Station for Bureau of Mines at Salt Lake City, Utah, by R. S. Dean and Cresap Moss. U. S. Bureau of Mines, Information Circular 7116; mimeographed.

Utilization of Natural Gas for Chemical Products, by Harold M. Smith. U. S. Bureau of Mines, Information Circular 7108; mimeographed.

Relationship of Ash-Fusion Temperatures of Coal and Coke, by D. A. Reynolds. U. S. Bureau of Mines, Report of Investigations 3505; mimeographed.

Phenomena Observed During the Prolonged Oxidation of Anthracite, by G. S. Scott and G. W. Jones. U. S. Bureau of Mines, Report of Investigations 3504; mimeographed.

Gaseous Products from Explosives—Some Factors Affecting Test Results, by John C. Holtz. U. S. Bureau of Mines, Report of Investigations 3507; mimeographed.

Equilibrium Cell for Investigating Properties of Fluids from Petroleum and Natural-Gas Reservoirs, by Kenneth Eilerts, R. Vincent Smith and R. C. Wright. U. S. Bureau of Mines, Report of Investigations 3514; mimeographed.

A Polarizing Comparison-Microscope for Use in Petrographic Measurements, by George T. Faust. U. S. Bureau of Mines, Report of Investigations 3503; mimeographed.

Cutting and Polishing Stones, by M. W. von Bernewitz and Frank Hess. U. S. Bureau of Mines, Information Circular 7107; mimeographed.

Quarry Drilling, by J. R. Thoenen and E. J. Lintner. U. S. Bureau of Mines, Report of Investigations 3502; mimeographed.

Safety Factors in Construction and Ventilation, Wawona Vehicular Tunnel, Yosemite National Park, Calif., by S. H. Ash. U. S. Bureau of Mines, Technical Paper 608; 20 cents.

Coke-Oven Accidents in the United States, 1938, by W. W. Adams and V. E. Wrenn. U. S. Bureau of Mines, Technical Paper 614; 5 cents.

Mineral Statistics. In anticipation of the publication of Minerals Yearbook 1940, various chapters are being preprinted and issued separately. The first item of this series to be released deals with potash. U. S. Bureau of Mines; 5 cents.

Permissible Electrically Operated Pumps, by L. C. Ilsley, E. J. Gleim, and H. B. Brunot. Bureau of Mines, Report of Investigations 3497; mimeographed.

The Designing for Strength of Flat Panels with Stressed Coverings, by J. A. Newlin. Available from Forest Products Laboratory, U. S. Department of Agriculture, Madison, Wisconsin.

Basic Industrial Markets in the United States—Commercial Power Laundry Industry. Bureau of Foreign and Domestic Commerce, Market Research Series No. 14.6. Available only from Bureau of Foreign and Domestic Commerce, Washington, D. C., at 25 cents per copy.

Federal Specifications. UU-P-121c. Paper; Bond, White and Colored; C-M-351b, Amendment-1. Milk, Dry, Powdered; Skimmed and Whole; TT-P-781. Putty and Elastic-Compound; (for) Metal-Sash-Glazing. 5 cents each.

War-Time Increases in Transportation Costs of Principal Imports. Available from U. S. Tariff Commission, Washington, D. C. or at Commission's office in the Custom House, New York, N. Y.; processed.

Silverware, Solid and Plated. U. S. Tariff Commission, Second Series Report No. 139; 25 cents.

Fuel Oils (Fifth Edition). National Bureau of Standards, Commercial Standard CS12-40; 5 cents.

Standardization of Packages. National Bureau of Standards, Miscellaneous Publication M165; 10 cents.

Surface Treatment of Steel Prior to Painting, by Rolla E. Pollard and Wilbur C. Porter. National Bureau of Standards, Building Materials and Structures Report BMS 44; 10 cents.

RECENT BOOKS and PAMPHLETS

Engineering Index. Volume 55. Published by Engineering Index, Inc., New York, N. Y. A book of some 1,400 pages with 27,000 annotations and 40,000 cross references, this annual index contains current data in all branches of engineering. Its material has been taken from 2,000 American and foreign periodicals and will serve to keep engineers and others abreast of the latest developments in the numerous lines of scientific endeavor.

Gas Distributing Companies Operating in the United States, as of Jan. 1, 1939. Published by Association of Gas and Appliance Equipment Manufacturers, 60 East 42nd St., New York, N. Y. 61 pages. Available to member companies at $1.00 per copy, to non-member companies at $25.00 per copy. A list arranged by states of the concerns engaged in public utility distribution of manufactured or natural gas. It identifies 973 such concerns with over 17 million customers, giving name, address, indication of type and heating value of gas and number of customers for each.

The Dictionary of Occupational Titles. Published by the U. S. Employment Service of the Department of Labor. 3 Volumes. Price $4. Defining 29,744 job titles which are applied to 17,542 different jobs in the farms, mines, factories, businesses and homes of the United States, this dictionary contains much information about jobs—what they are, where they exist and how they are performed. It is designed primarily for use in employment offices, and should be useful for statisticians and also personnel and vocational guidance workers.

Proceedings of the Seventh Summer Conference of Spectroscopy and its Applications. Published by John Wiley & Sons, Inc., New York, N. Y. 154 pages. Price $2.75. A collection of 28 papers which were presented at the summer conference, July 1939. Condensed, edited and well indexed these papers represent some of the latest information in various applications of spectroscopy.

100 Packaging Case Histories. Compiled by Albert Q. Maisel. Published by Breskin Publishing Corp., New York, N. Y. 223 pages. An illustrated book showing old and new packages. Product data, market areas and marketing conditions, comparative package data, plant changes and sales achievements are given for each container.

Pacific Northwest Mineral Maps. A well prepared set of maps issued under the direction of Ivan Bloch, chief of market development section, The Bonneville Project of the United States Department of the Interior. There are 40 of these maps, each one showing the approximate locations of deposits of a mineral substance. Complete and up-to-date as of Jan. 1, 1940.

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Agitators. Patterson Foundry & Machine Co., East Liverpool, Ohio—4-page leaflet describing construction features of the improved type m40 Unipower agitator drive made by this company.

Air Dehydration. Aqua-Sorb Co., East Orange, N. J.—4-page leaflet describing various models of this company's Aqua-Sorber for the absorption of moisture from air through the use of Aqua-Sorb, a hygroscopic absorptive solid.

Alloys. Alloy Metal Wire Co., Prospect Park, Pa.—4-page folder describing properties and applications of Inconel wire products.

Carbon and Graphite. Great Lakes Carbon Corp., 910 South Michigan Ave., Chicago, Ill.—72-page booklet on carbon and graphite electrodes, graphite anodes, and petroleum carbon, with information on properties and applications and numerous tables of useful information.

Certrifugals. The National Acme Co., 170 East 131st St., Cleveland, Ohio—Catalog P-41—16 pages on this company's long bowl type centrifugals, with information on construction, types and applications. Several flow sheets and application illustrations are included.

Chemicals. R. & H. Chemicals Dept., E. I. duPont de Nemours & Co., Wilmington, Del.—New technical service manual on Cadalyte salt for cadmium plating, with information on operation and maintenance of plating solutions.

Cleaners. Homestead Valve Mfg. Co., Coraopolis, Pa.—Bulletin J-24025 — 4 pages describing this company's Hypressure Jenny, a pressure steam cleaner, for cleaning equipment, floors, buildings, etc.

Copper and Alloys. Revere Copper & Brass, Inc., 230 Park Ave., New York, N. Y.—32-page data book giving weights and data for copper, brass and bronze products with additional tables of useful information.

Detergents. Rohm & Haas Co., 222 West Washington Square, Philadelphia, Pa.—11-page booklet on Triton 720, a synthetic detergent which in use is stated not to be precipitated nor decomposed, nor to lose its effectiveness.

Dryers. Buffalo Foundry & Machine Co., Buffalo, N. Y.—Bulletin No. 324—24 pages on this company's rotary vacuum dryers, with detailed information on construction and available arrangements.

Electrical Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin B-6033—28 pages on coupled and engine types of synchronous motors with detailed information on design and control and data on numerous typical applications.

Electrical Equipment. Burndy Engineering Co., 459 East 133d St., New York, N. Y.—Bulletin 6000—16-page electrical connector guide, describing methods for surveying existing conditions of electrical connections, and discussing proper selection.

Electrical Equipment. Durakool, Inc., 10 North Main St., Elkhart, Ind.—Leaflet describing this company's new unbreakable mercury relay, consisting of a metal mercury switch of this company's well-known type, containing a displacement plunger actuated by a solenoid.

Electrical Equipment. Micro-Switch Corp., Freeport, Ill.—Data Sheets 11 and 12—Describe recently developed types of Micro-Switch made by this company including special roller actuated switches and panel mounted types.

Electrical Equipment. U. S. Electrical Motors, Inc., 200 East Slauson Ave., Los Angeles, Calif.—5-page bulletin on design and operation of this company's capacitor-start, single-phase motors.

Engines. Chicago Pneumatic Tool Co., 6 East 44th St., New York, N. Y.—Bulletin 768, Second Edition—16 pages on this company's Types 8 and 9 diesel engines for continuous heavy-duty stationary service, with rating information and details on design.

Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletins B-6034 and B-6088—Respectively 28 and 8 pages describing in detail four general types of jaw crusher, the fine reduction, Dodge, Blake and Superior types with information on construction features, capacities and dimensions; and information on this company's Sta-Kleen screen with description and case histories on applications.

Equipment. American Foundry Equipment Co., 555 South Byrkit St., Mishawaka, Ind.—Catalog 60—12-page reference catalog covering the entire line of products made by this company including dust collectors, abrasive blasting equipment and numerous types of foundry equipment.

Equipment. The J. H. Day Co., Cincinnati, Ohio—Bulletin 352—16-pages on this company's numerous types of sifters and mixers for all dry powdered and granular materials and for wet materials and pastes.

Equipment. The Drever Co., 748 East Venango St., Philadelphia, Pa.—4-page folder describing a line of novel processing kettles for varnish, resins, ester gums, fatty acids, etc., produced by this company for chemical industry use.

Equipment. Farrel-Birmingham Co., Ansonia, Conn.—Bulletin 7-R-702—4-page leaflet giving news of equipment made by this company, including new plastics mills and rubber machinery.

Equipment. Link-Belt Co., 307 North Michigan Ave., Chicago, Ill.—Publications as follows: Catalog 1640, 96 pages on this company's sugar factory equipment including mechanical handling and power transmitting equipment of numerous types; Catalog 1762, 20 pages on this company's vibrating screens with information on a wide variety of applications; Catalog 1782, 8 pages on automatic coal stokers of various types and sizes to 300 hp.

Equipment. Vulcan Iron Works, Wilkes-Barre, Pa.—16-page bulletin describing this company's kilns, roasters, coolers and dryers, with information on design, approximate capacities and structural details.

Equipment. Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.—Publications as follows: EJ-1907, 16 pages on this company's gun-packed expansion joints for steam lines with description and technical information; G-1305, 12-page condensed catalog covering all of this company's major products in steam plant equipment; T-1735, 16 pages giving complete information on standard and special types of Impulse steam traps made by this company.

Fans. Truflo Fan Co., Harmony, Pa.—4-page leaflet describing this company's wall fans and automatic shutters with information also on roof ventilating fans and roof pent-houses for ventilators.

Filters. T. Shriver & Co., 808 Hamilton St., Harrison, N. J.—Bulletin 108—8 pages on the application of filter presses in electroplating, with information on advantages, methods, equipment and selection.

Fittings. Bonney Forge & Tool Works, Allentown, Pa.—Bulletin WT29—20 pages on this company's weld fittings, including types for welded connections, threaded connections and a socket-end type for welding.

Fluids Handling. The Pittsburgh Brass Mfg. Co., 3210 Penn Ave., Pittsburgh, Pa.—Catalog 3—40 pages describing this company's line of cocks, hose couplings, fittings, swing unions, ball pipe joints and other bronze equipment of this type with prices and tables of useful information.

Instruments. Fischer & Porter Co., 110 West Penn St., Germantown, Philadelphia, Pa.—Catalog Section 80-A—12 page bulletin completely describing the theory of the rotameter flowmeter, said to be the first such complete treatise available to industry. Includes section on rotameter capacities and corrections.

Instruments. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.—Broadside N-33—12 pages describing this company's Micromax and other pyrometers including recorders, controllers and radiation and optical pyrometers.

Laboratory Equipment. Fisher Scientific Co., 711 Forbes St., Pittsburgh, Pa.—12-page catalog on laboratory hardware of numerous sorts manufactured of Castaloy, a non-brittle corrosion-resisting alloy material.

Leak Prevention. Carbide & Carbon Chemicals Corp., 30 East 42d St., New York, N. Y.—20-page book on correcting leakage in gas distribution systems with Carboseal Anti-Leak, giving information about properties and use of this material, methods of application, costs, results of treatment, and effects other than leak prevention secured by treatment.

Magnetic Separators. Stearns Magnetic Mfg. Co., Milwaukee, Wis.—Bulletin 46-B — Describes this company's high-duty type L magnetic separator for reclaiming mixed materials and purifying materials from contained iron.

Metal Hose. Chicago Metal Hose Corp., Maywood, Ill.—Catalog C-21—38 pages on this company's flexible metal hose, containing information on numerous applications, with details on new stainless steel types and on steam hose.

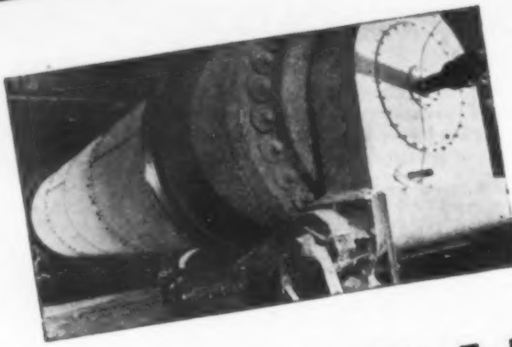
Packing. Belmont Packing & Rubber Co., 3636 Sepviva St., Philadelphia, Pa.—Catalog on this company's packing materials, giving full information on each type, with tabulated recommendation charts and engineering data.

Piping Design. Power Piping Div., Blaw-Knox Co., 1525 Pennsylvania Ave., Pittsburgh, Pa.—90 page wire-bound book in stiff covers, entitled "Flex-Anal Charts," a treatise on the design of piping for flexibility, prepared after ten years of work by E. A. Wert and S. Smith of the Detroit Edison Co. Available without charge to qualified engineers and executives writing on letter head; priced $3 to others. The book presents a large number of charts and simplified formulas which enable the piping engineer to determine stresses, forces, moments and reflections in piping designs of one-, two- and three-plane structures, greatly reducing the time required for such work in comparison with previously available methods.

Refractories. General Refractories Co., Philadelphia, Pa.—Bulletin 209—4-page leaflet describing sillimanite refractories made by this company, including brick, cement and plastic refractories, with information on properties, performance and suggested applications.

Refractory Concrete. The Atlas Lumnite Cement Co., 135 East 42d St., New York, N. Y.—24-page bulletin on refractory concrete made with this company's Lumnite cement, with information on heat resistance, mixtures for various types of installations, and types of service obtained.

Safety Equipment. Boyer-Campbell Co., 6540 Antoine St., Detroit, Mich.—Price List No. 4 for Safety Catalog No. 40—60-page price list covering numerous types of safety equipment including face and eye shields, goggles, helmets and welding protective equipment, respirators and gas masks, protective clothing, first aid equipment, fire extinguishers, etc.



LOUISVILLE DRYER RETURNS 62% OF ITS COST IN 60—75 DAYS!

If you are in a *seasonal* industry, or if your operations could be improved by *occasional* use of a proper drying system, please study the figures in the "blueprint" at the right.

Here is a case in which a dryer could be used for only 60 to 75 days a year. For many years, the company had felt that no reclaiming system could successfully "pay its way," over such a short season. Yet today, their Louisville Dryer is actually paying a 62% annual dividend on its $18,000 investment—has already paid for itself, several times over!

PREVIOUS SYSTEM

Waste materials from processes were carted away and dumped at a cost of approximately $1,500 per season (60 to 75 days per annum).

PRESENT SYSTEM

(Louisville Rotary Dryer Plant)

Analysis proved dried wastes to be excellent feed, readily saleable at $25 per ton.

Tons dried per season . . 550
Value as feed . . $13,750.00
Drying costs, including amortization charges . 4,100.00
Net annual revenue $9,650.00

SUMMARY

Revenue from dried product . . . $9,650.00
Previous carting costs 1,500.00
Total annual savings $11,150.00

ANNUAL RETURN ON INVESTMENT, 62%

Tell us *your* needs. Our engineering department will gladly work out a detailed report on your drying possibilities, together with an accurate analysis of the cost and profit figures you could expect from a Louisville Drying System. Then you judge for yourself. *Address:* Louisville Drying Machinery Company, Incorporated, 451 Baxter Avenue, Louisville, Kentucky.

DEMAND FOR CHEMICALS TURNED UPWARD LAST MONTH ALTHOUGH FOREIGN TRADE WAS LESS ACTIVE

Chem & Met ECONOMICS and MARKETS

SEVERAL of the important consuming industries stepped up operations last month with a corresponding increase in demand for chemicals and related products. Activities at steel mills were prominent in the upward movement and more favorable weather conditions aided in the belated call for paint-making materials. Reports from petroleum refineries indicated a consumption well in excess of 111,000,000 bbl. of crude oil which would represent an all-time monthly high for that industry. Growing inventories at glass works have tended to check the rate of production and the passing of the active mixing season has curtailed the use of fertilizer chemicals. Conditions at textile plants have been mixed with prospects favoring some falling off in the immediate future.

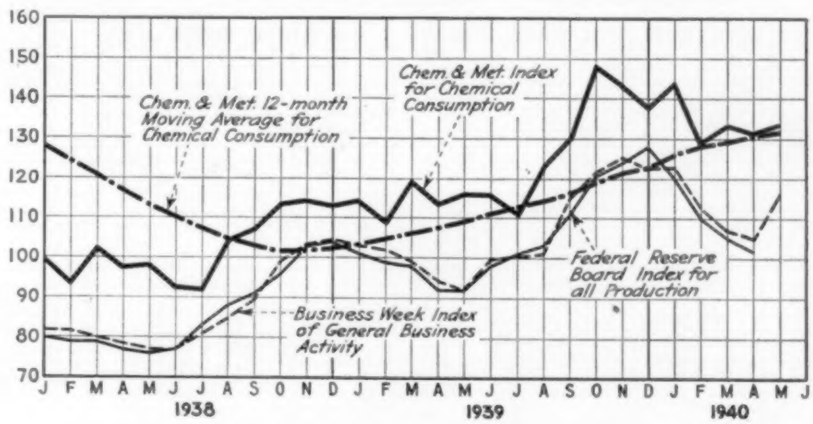
The preliminary index for consumption of chemicals in May is 135 which compares with a revised figure of 132.19 for April and with 116.49 for May of last year. From early June reports it would appear that the index for consumption of chemicals for the first half of this year will show a gain of approximately 17 per cent over that for the corresponding period of last year. As this index takes into consideration only domestic consumption, it is evident that production of chemicals has been at a relatively higher rate in order to take care of the sharp increase in demand which has come from outside this country.

Chem. & Met. Index for Consumption of Chemicals

	March revised	April
Fertilizer	27.70	26.83
Pulp and paper	18.79	18.00
Glass	13.20	12.54
Petroleum refining	14.36	13.82
Paint and varnish	10.27	12.22
Iron and steel	8.57	7.83
Rayon	11.17	11.34
Textiles	7.82	7.81
Coal products	8.36	8.14
Leather	3.70	3.59
Explosives	4.41	4.55
Rubber	3.09	2.96
Plastics	2.64	2.56
	134.08	132.19

As more complete data were received covering manufacturing operations in April, it was seen that the rather sharp drops as earlier reported for some of the consuming industries had been exaggerated. For instance, the output of superphosphate which usually declines materially from March to April, was lowered only a little over 3 per cent this year. In fact, the April output, with the exception of that for April 1937, was the largest reported for that month in the present series of the Department of Commerce. The drop in flat glass production was partly offset by a larger output of containers. Rayon production appears to be going ahead at capacity and the increase in unsold stocks has not yet become important. Sales of paint, varnish, and lacquer jumped about 20 per cent and were still moving upward at the close of the month.

Sales of manufacturers as compiled by the Bureau of the Census in cooperation with the National Association of Credit Men, were 16.8 per cent higher in April than in the like month of 1939. Each of the major industry groups included in this compilation, shared in the increase over last year. For chemicals the increase was placed at 16.7 per cent and it also was reported that sales in April were 11.5 per cent above those for the preceding month. Federal Reserve Board index advanced to 105 in May.



In the eight-month period following the outbreak of hostilities in Europe, from September 1939 to April 1940, inclusive, exports of chemicals and related products were valued at $167,333,500, compared with $108,939,500 in the corresponding months of 1938-39, a value gain of more than 50 per cent.

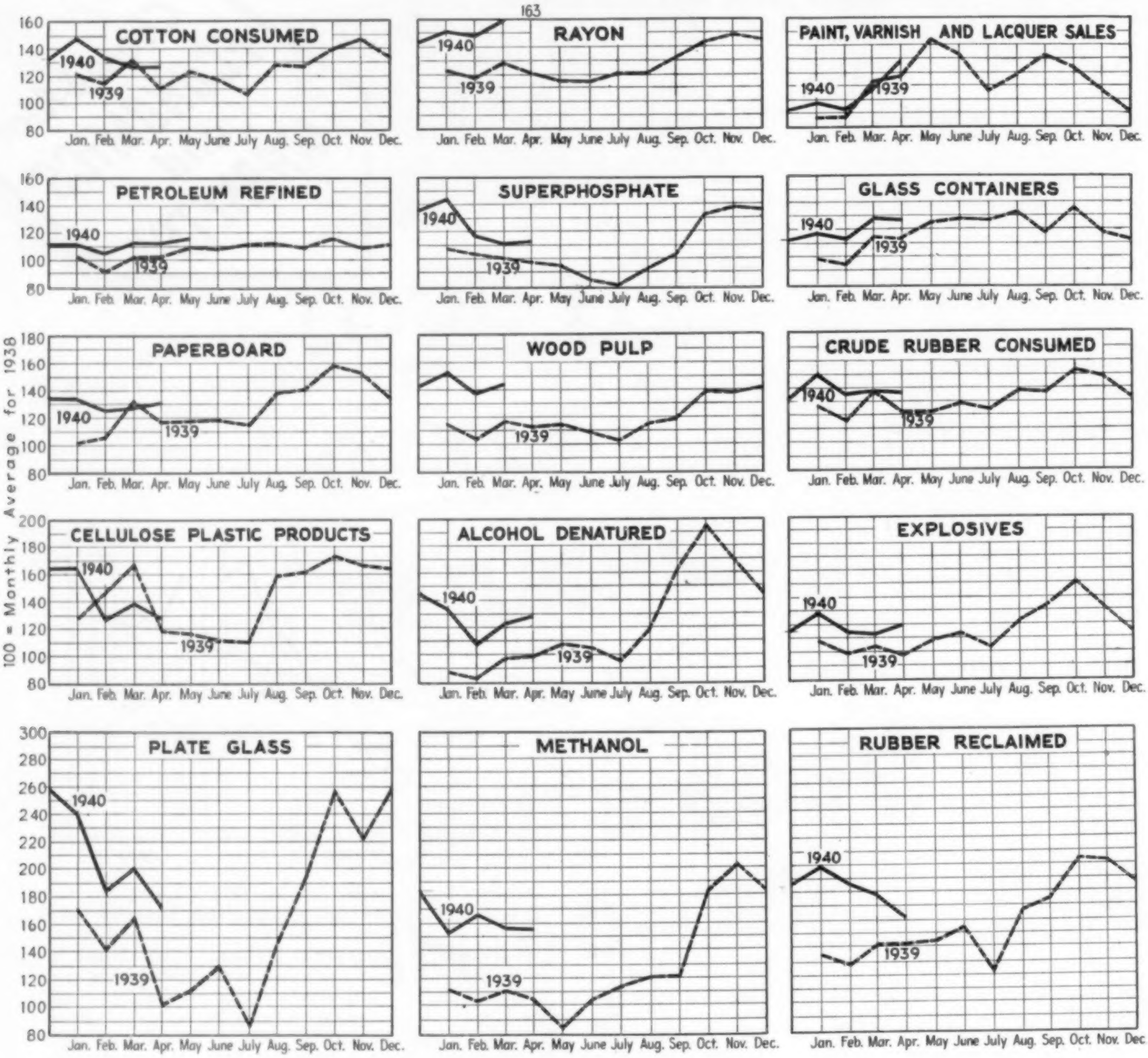
1939 output of miscellaneous non-coal-tar synthetic organic chemicals was 2,946,151,000 lb., or 24 per cent more than in 1938. Among the important products that advanced were acetic acid 23 per cent, acetic anhydride 58 per cent, butyl alcohol 56 per cent, carbon tetrachloride 16 per cent, ethyl acetate 22 per cent, and isopropyl alcohol 28 per cent. Sales of acetone were up 50 per cent, and of synthetic methanol 39 per cent.

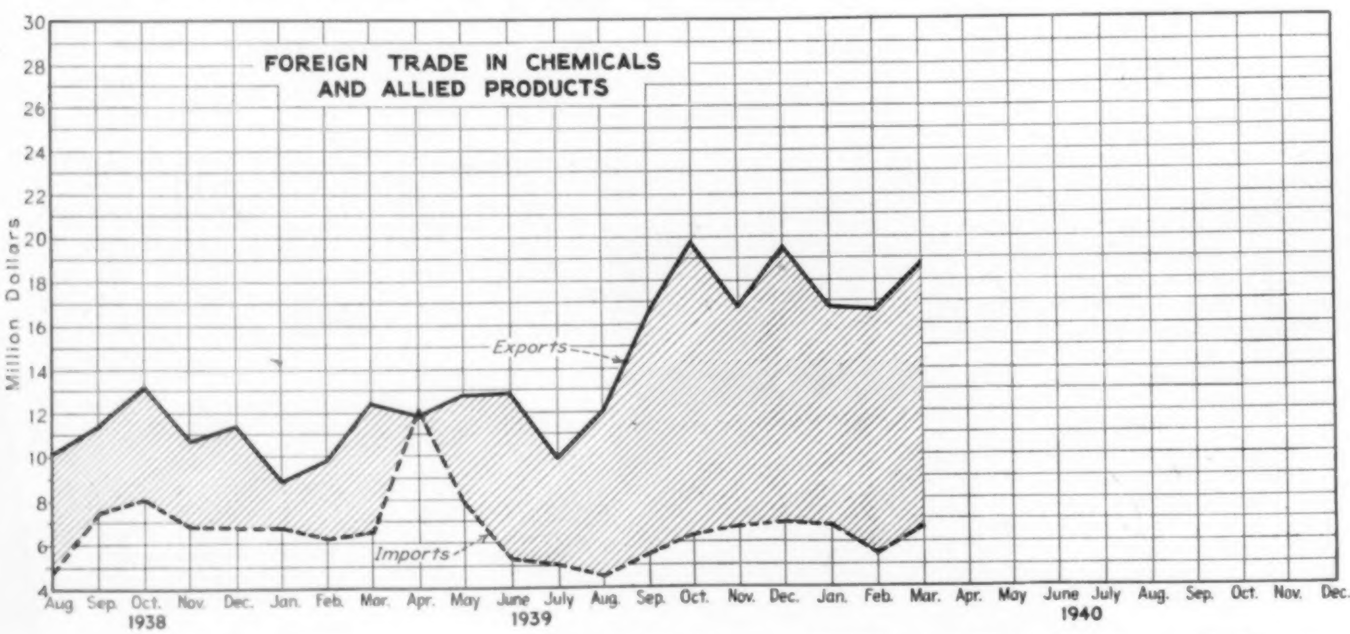
Production and Consumption Data for Chemical-Consuming Industries

Production	April 1940	April 1939	Jan.–April 1940	Jan.–April 1939	Per cent of gain for 1940
Alcohol, ethyl, 1,000 pr. gal.	20,218	17,857	82,238	67,012	22.7
Alcohol denatured, 1,000 wi. gal.	9,994	7,719	38,376	28,608	34.1
Ammonia, liquor, 1,000 lb.	4,327	3,565	18,172	15,104	20.3
Ammonium sulphate, tons	54,570	39,635	224,496	173,841	29.1
Automobiles, sales, No.	432,746	337,375	1,692,677	1,354,709	24.9
Benzol, 1,000 gal.	9,588	6,813	40,659	29,805	36.4
Byproduct coke, 1,000 tons	3,984	2,915	16,833	12,798	31.5
Glass containers, 1,000 gr.	4,584	4,071	17,576	15,167	15.9
Plate glass, 1,000 sq. ft.	12,367	7,268	57,101	41,509	37.6
Window glass, 1,000 boxes	1,023	740	4,642	3,404	36.4
Methanol, crude, gal.	441,888	389,423	1,852,911	1,441,894	28.5
Methanol, synthetic, gal.	3,486,233	2,276,385	14,184,258	9,413,172	50.7
Nitrocellulose plastics, 1,000 lb.	852	1,116	4,197	4,404	4.7*
Cellulose acetate plastics, 1,000 lb.:					
Sheets, rods, and tubes.	558	508	2,603	3,471	25.0*
Molding composition	951	736	4,203	3,296	27.5
Superphosphate, tons	351,776	302,813	1,533,060	1,272,674	20.5
Consumption					
Cotton, bales	623,893	543,187	2,643,026	2,353,839	12.3
Silk, bales	21,740	27,802	95,416	139,700	31.7*
Wool, 1,000 lb.	26,015	27,726	118,916	125,642	5.2*
Explosives, 1,000 lb.	32,204	26,341	128,118	109,991	16.5
Rubber, crude, tons	50,103	44,166	205,105	182,930	12.1
Rubber, reclaimed, tons	16,298	13,391	68,563	54,239	26.4

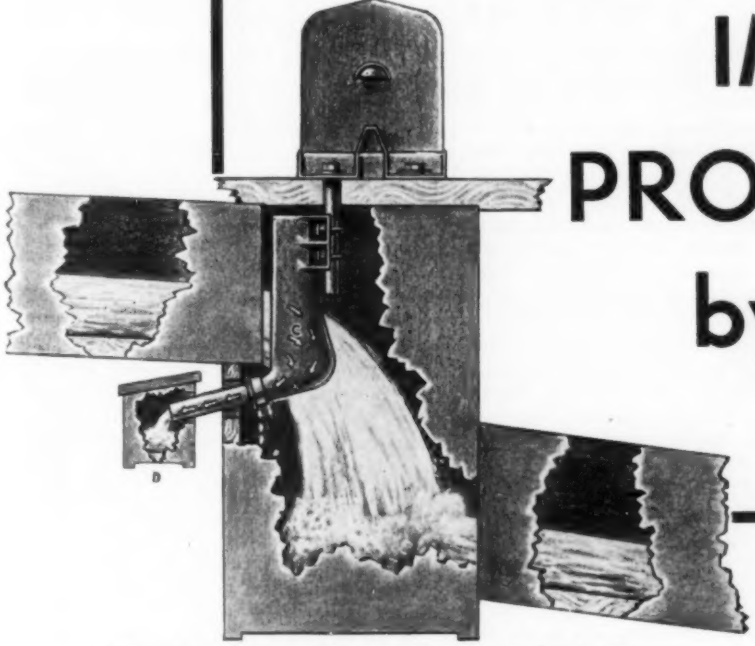
* Per cent of decline.

Production and Consumption Trends





IMPROVED PRODUCTION by Accurate Control



★ *How to sample wet materials flowing in a sloping launder, flume, or pipe. Sample enters Cutter "C" as it travels across the stream, flows through cutter in the direction of the arrows, and is collected in any desirable manner at "D".*

The GEARY-JENNINGS Sampler takes an accurate representative and automatic sample of any mill stream whether it be corrosive liquids or dry materials. This is of particular interest to the mill operator in that the GEARY-JENNINGS Sampler, with an enviable reputation for accuracy, gives definite information on materials that are, or that make up his product and establishes a control of production based on sound operating principles.

A slight change in the constituents that produce a better product will be faithfully recorded by the GEARY-JENNINGS Sampler. Such advantages are quite apparent. An unexpected fluctuation in the product due to the fact that few materials are homogenous or from other causes can also be quickly corrected from the sampler check. Best of all, however, every mill operator can definitely know the elements comprising each article of each day's production. These valuable statistics, which result in better operations and a higher quality product will further the goal of increased profits.

The GEARY-JENNINGS Sampler is known, used, and praised in practically every country over the globe for its dependability, rugged construction and noteworthy features. These features are explained and illustrated in our Bulletin No. 361 which is available on request. Write Dept. S-2.

★ *Diagram showing how to sample dry materials. Materials may be sampled falling from a chute, as shown, or from a conveyor head pulley.*

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There is No Substitute for Experience and Service

CONTRACT DELIVERIES OF CHEMICALS ARE RUNNING TO LARGER VOLUME THIS MONTH

THE present month started with a good call for materials against contract commitments and as some of the large consuming branches are now operating in a more active way, deliveries for the month bid fair to show some increase over the totals moved in May. There has been a little more interest shown in the spot market on the part of domestic buyers and while export inquiries are reported to have fallen off in volume in the last three months, there still is a larger-than-normal trade which is going through as direct transactions between buyers and producers. The export situation, however, has become more complicated with some markets, temporarily at least, cut off from suppliers and with the probability that this situation is to become still more in evidence.

Plans for increasing domestic outputs of various products which enter into our defense program, point to a larger demand for chemicals from domestic consumers. Should the normal channels of trade continue without interruption, a marked increase in chemical outputs would seem logical.

With a larger prospective demand for chemicals, there is considerable interest in the effect this may have upon price movements. Judging from the relative stability of the market throughout the final quarter of last year when consuming demand was quickly jumped to a high level, somewhat similar results may be expected for the future. Producers of chemicals are maintaining a policy of supplying their regular customers at practically unchanged figures. As demand from this source combined with sales for export have taken up the greater part of production, there have been only limited surpluses which have found their way into the open market and speculative trading has been of minor importance. There seems to be no reason for any change in this policy.

The price movement in the past month has revealed no indication of a trend in either direction. Revisions, both up and down, have been announced but the great majority of chemicals are holding the steady course which has been in effect for several months. The influence of the changes which did take place was in favor of a lower price level with a fractional drop in the weighted index number.

In contrast with the position of the chemical market, was the weakness which pervaded the market for oils and fats. Reductions in price were almost universal in the vegetable oil list and the same was true for animal fats. A very sharp drop was recorded in the index number. Export inquiry for oils and fats has not been important and as stocks are large the market has been under competitive influences and while this condition may be expected to continue, it is reported that some large consumers have been quietly accumulating supplies.

Some time ago reports to the Department of Commerce stated that production of rayon in Italy had been curtailed because caustic soda was not available. A more recent report says the threatened scarcity of caustic soda supplies for Italian artificial fiber plants, owing to the inability of Italian producers of soda to keep up their production at the necessary level because of the coal shortage, has been averted by the importation of additional amounts of this chemical from French producers. Sufficient supplies were made available in France by the shutting-down of a number of artificial fiber factories near the German boundary, with the result that the entire production of a French caustic soda plant near the Italian border has been made available to Italian fiber manufacturers at prices that compare favorably with the Italian prices.

The ten Japanese producers of sodium silicate have formed, at the instance of the Government a producers guild. This move apparently contemplates regulation of production and sales for sodium silicate. Nippon Seiren and the Toyo Soda Kogyo organizations are said to be the chief factors in the production of sodium silicate in Japan. Annual capacity is placed at 80,000 metric tons.

It is reported that a chemical company in California has developed for agricultural use a cheap magnesia derived from bitterns. In recent years there has been a marked increase in demand for magnesia in the fertilizer industry and for direct application to reduce soil acidity. Imports formerly were of considerable volume in the form of kainit, sulphate of potash-magnesia, and calcined krescrite and use of the seawater product has been aided by cutting down imports.

CHEM & MET.
Weighted Index of
CHEMICAL PRICES

Base = 100 for 1937

This month	**98.57**
Last month	98.71
June, 1939	97.21
June, 1938	99.88

Scattered price revisions have been put into effect in a two-way movement with the majority of the more important chemicals holding an unchanged position. Tartaric acid and cream of tartar have been advanced in price and turpentine and calcium chloride are among the selections which have **declined.**

Shipments of American chemicals and related materials to foreign countries continued active in April, although at a slightly lower level than during the preceding month, according to the Department of Commerce. Exports in April were valued at $19,350,500 compared with $21,119,000 during the preceding month and $14,658,500 in April 1939.

As in the early months of the year, sharp increases were recorded in export of dyes, medicinals, industrial chemicals, sulphur, and miscellaneous other products, including soaps, printing inks, crude drugs, and industrial explosives.

Exports of all types of coal-tar products were valued at $1,995,500 in April compared with $989,600 in the corresponding month of last year. The gain was due very largely to heavier demand for American coal-tar dyes. Exports of such products during the month aggregated 1,967,500 lb. valued at $1,092,000 against 814,760 lb. valued at $326,500 in April 1939. Exports of benzol during these periods declined from 1,631,700 to 31,000 gal.

Exports of industrial chemicals increased 77 per cent in value to $4,174,700 in April over the $2,354,600 recorded during the corresponding month of 1939. In this group, exports of sodium compounds increased from 46,317,000 to 55,311,000 lb. in quantity and in value from $928,000 to $1,580,000. Corresponding gains were recorded with certain other items included in the classification.

Other items and groups among the chemicals and related products recording export gains in April compared with the corresponding month of 1939 included sulphur, both crude and refined, shipments of which increased in value from $979,400 to $1,517,000; naval stores, from $1,144,000 to $1,374,000; crude drugs, from $82,400 to $122,350; chemical specialties, from $2,720,000 to $2,937,300; essential oils, from $263,246 to $273,375; paints and pigments, from $1,909,700 to $1,944,750; fertilizers, from $1,161,000 to $1,209,000; industrial explosives, from $285,000 to $391,000; soaps, from $205,000 to $233,000; and printing inks, from $64,000 to $132,000.

CHEM & MET.

Weighted Index of Prices for

OILS & FATS

Base = 100 for 1937

This month	73.36
Last month	78.88
June, 1939	71.09
June, 1938	72.34

Price declines were fairly general throughout the list of vegetable oils and animal fats joined in the declining price trend. Buying interest was moderate and as stocks of edible oils are plentiful, the undertone was weak. The statistical position of lard also is a bearish factor.

Chem & Met Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.07½–$0.08	$0.07½–$0.08	$0.05½–$0.06½
Acid, acetic, 28%, bbl., cwt	2.23 – 2.48	2.23 – 2.48	2.23 – 2.48
Glacial 99%, drums	8.43 – 8.68	8.43 – 8.68	8.43 – 8.68
U. S. P. reagent	10.25 –10.50	10.25 –10.50	10.25 –10.50
Boric, bbl., ton	106.00–111.00	106.00–111.00	106.00–111.00
Citric, kegs, lb	.20 – .23	.20 – .23	.20½– .23
Formic, cbys., lb	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb	.90 – 1.00	.90 – 1.00	.70 – .75
Hydrofluoric 30% drums, lb	.08 – .08½	.08 – .08½	.07 – .07½
Lactic, 44%, tech., light, bbl., lb	.06½– .06¾	.06½– .06¾	.06½– .06¾
Muriatic, 18°, tanks, cwt	1.05 –......	1.05 –......	1.05 –......
Nitric, 36°, carboys, lb	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –......	18.50 –20.00
Oxalic, crystals, bbl., lb	.10½– .12	.10½– .12	.10½– .12
Phosphoric, tech., c'bys., lb	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –......	13.00 –......	13.00 –......
Sulphuric, 66°, tanks, ton	16.50 –......	16.50 –......	16.50 –......
Tannic, tech., bbl., lb	.54 – .56	.54 – .56	.40 – .45
Tartaric, powd., bbl., lb	.39½–......	.37½–......	.27½–......
Tungstic, bbl., lb	nom.	nom.	2.75 –......
Alcohol, amyl	......–......	......–......	......–......
From Pentane, tanks, lb	.101–......	.101–......	.101–......
Alcohol, Butyl, tanks, lb	.09 –......	.09 –......	.07½–......
Alcohol, Ethyl, 190 p'f., bbl., gal	4.54 –......	4.54 –......	4.54 –......
Denatured, 190 proof	......–......	......–......	......–......
No. 1 special, bbl., gal. wks	.29½–......	.29½–......	.26½–......
Alum, ammonia, lump, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Potash, lump, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Aluminum sulphate, com. bags, cwt	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt	1.60 – 1.70	1.60 – 1.70	1.30 – 1.55
Aqua ammonia, 26°, drums, lb	.02½– .03	.02½– .03	.02 – .03
tanks, lb	.02 – .02¾	.02 – .02¾	.02 – .02¾
Ammonia, anhydrous, cyl., lb	.16 –......	.16 –......	.15½– .16
tanks, lb	.04½–......	.04½–......	.04½–......
Ammonium carbonate, powd. tech., casks, lb	.09 – .12	.09 – .12	.08 – .12
Sulphate, wks., cwt	1.40 –......	1.40 –......	1.40 –......
Amylacetate tech., from pentane, tanks, lb	.11½–......	.11½–......	.10½– .10½
Antimony Oxide, bbl., lb	.12 – .15	.15	.11 – .12
Arsenic, white, powd., bbl., lb	.03 – .03½	.03 – .03½	.03 – .03½
Red, powd., kegs, lb	.17 – .18	.17 – .18	.15½– .16
Barium carbonate, bbl., ton	52.50 –57.50	52.50 –57.50	52.50 –57.50
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb	.09 – .10	.07 – .08	.07 – .08
Blanc fixe, dry, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f. o. b., wks., drums, cwt	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton	43.00 –......	43.00 –......	48.00 –51.00
Bromine, cs., lb	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	1.90 –......	1.90 –......	1.65 –......
Arsenate, dr., lb	.06½– .06¾	.06½– .06¾	.06½– .07
Carbide drums, lb	.04½– .05	.04½– .05	.05 – .06
Chloride, fused, dr., del., ton	19.00 –24.50	21.50 –24.50	21.50 –24.50
flake, dr., del., ton	20.50 –25.00	23.00 –25.00	23.00 –25.00
Phosphate, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb	.05 – .06	.05 – .06	.05 – .06
Tetrachloride drums, lb	.04½– .05½	.04½– .05½	.04½– .05½
Chlorine, liquid, tanks, wks., lb	1.75 –......	1.75 –......	1.75 –......
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb	1.84 – 1.87	1.84 – 1.87	1.67 – 1.70
Copperas, bgs., f. o. b., wks., ton	18.00 –19.00	17.00 –18.00	15.00 –16.00
Copper carbonate, bbl., lb	.10 – .16½	.10 – .16½	.10 – .16
Sulphate, bbl., cwt	4.60 – 4.85	4.60 – 4.85	4.10 – 4.35
Cream of tartar, bbl., lb	.32½–......	.30½–......	.22½–......
Diethylene glycol, dr., lb	.22 – .23	.22 – .23	.22 – .23
Epsom salt, dom., tech., bbl., cwt	1.80 – 2.00	1.80 – 2.00	1.80 – 2.00
Ethyl acetate, drums, lb	.07 –......	.07 –......	.061–......
Formaldehyde, 40%, bbl., lb	.05½– .06	.05½– .06½	.05½– .06½
Furfural, tanks, lb	.09 –......	.09 –......	.09 –......
Fusel oil, ref. drums, lb	.16 – .17	.16 – .17	.12½– .14
Glaubers salt, bags, cwt	.95 – 1.00	.95 – 1.00	.95 – 1.00
Glycerine, c.p., drums, extra, lb	.12½–......	.12½–......	.12½–......
Lead:			
White, basic carbonate, dry casks, lb	.07 –......	.07 –......	.07 –......
White, basic sulphate, sck., lb	.06½–......	.06½–......	.06½–......
Red, dry, sck., lb	.07½–......	.07½–......	.07½–......
Lead acetate, white crys., bbl., lb	.11 – .12	.11 – .12	.10 – .11
Lead arsenate, powd., bag, lb	.08½– .11	.08½– .11	.10 – .10½
Lime, chem., bulk, ton	8.50 –......	8.50–......	8.50 –......
Litharge, pwd., csk., lb	.06½–......	.06½	.06½–......
Lithophone, bags, lb	.036– .04	.036– .04	.04½– .05
Magnesium carb., tech., bags, lb	.06½– .06½	.06½– .06½	.06 – .06½

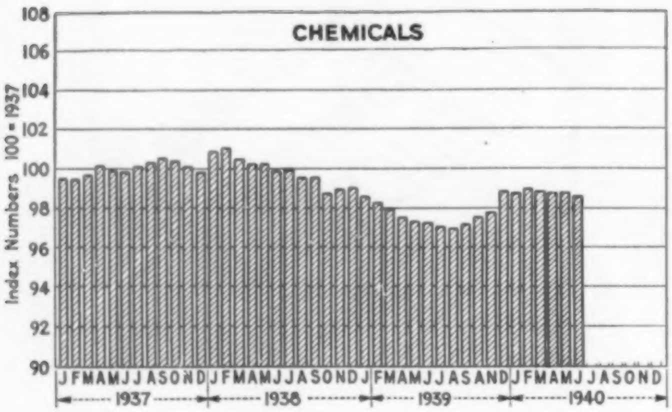
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to June 13

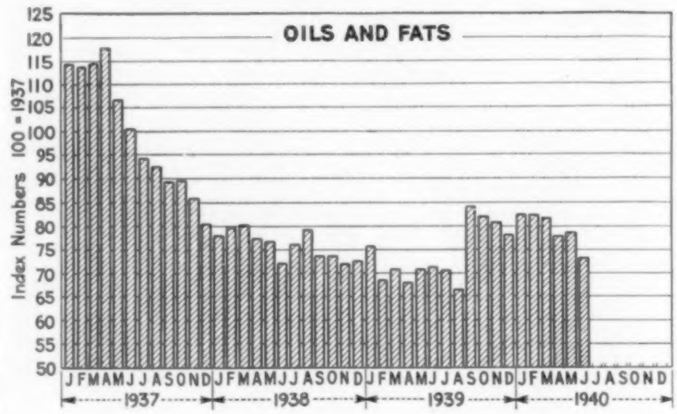
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	.29 –......	.29 –......	.31 –......
97%, tanks, gal	.30 –......	.30 –......	.32 –......
Synthetic, tanks, gal	.30 –......	.30 –......	.33 –......
Nickel-salt, double, bbl., lb	.13 – .13½	.13 – .13½	.13 – .13½
Orange mineral, csk., lb	.10½–......	.10½–......	.10½–......
Phosphorus, red, cases, lb	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb	.08½– .09	.08½– .09	.08½– .09
Carbonate, 80–85%, calc. csk., lb	.06½– .07	.06½– .07	.06½– .07
Chlorate, powd., lb	.10 – .12	.10 – .12	.09½–......
Hydroxide(c'stic potash) dr., lb	.07 – .07½	.07 – .07½	.07 – .07½
Muriate, 80% bgs., unit	.53½–......	.53½–......	.53½–......
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb	.18½– .19	.18½– .19	.18½– .19
Prussiate, yellow, casks, lb	.15 – .16	.15 – .16	.14 – .15
Sal ammoniac, white, casks, lb	.05 – .06	.05 – .06	.05 – .05½
Salsoda, bbl., cwt	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	23.00 –......	23.00 –......	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt	1.05 –......	1.05 –......	1.05 –......
Dense, bags, cwt	1.10 –......	1.10 –......	1.10 –......
Soda, caustic, 76%, solid, drums, cwt	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, works, bbl., lb	.04 – .05	.04 – .05	.04 – .05
Bicarbonate, bbl., cwt	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb	.06½– .07	.06½– .07	.06½– .07
Bisulphate, bulk, ton	16.00 –17.00	15.00 –16.00	15.00 –16.00
Bisulphite, bbl., lb	.03 – .04	.03½– .04	.03½– .04
Chlorate, kegs, lb	.06½– .06½	.06½– .06½	.06½– .06½
Cyanide, cases, dom., lb	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb	.07 – .08	.07 – .08	.07½– .08
Hyposulphite, bbl., cwt	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt	2.35 – 2.40	2.35 – 2.40	2.20 – 3.20
Nitrate, bulk, cwt	1.45 –......	1.45 –......	1.45 –......
Nitrite, casks, lb	.06½– .07	.06½– .07	.06½– .07
Phosphate, tribasic, bags, lb	2.25 –......	2.25 –......	2.10 –......
Prussiate, yel. drums, lb	.10½– .11	.10½– .11	.09½– .10
Silicate (40° dr.) wks., cwt	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr., lb	.02½– .03½	.02½– .03	.02½– .03
Sulphite, crys., bbl., lb	.02½– .02½	.02½– .02½	.02½– .02½
Sulphur, crude at mine, bulk, ton	16.00 –......	16.00 –......	18.00 –......
Chloride, dr., lb	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb	.07 – .08	.07 – .08	.07 – .07½
Flour, bag, cwt	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb	.51 –......	.51 –......	.52 –......
Crystals, bbl., lb	.41½–......	.36½–......	.38 –......
Zinc. chloride, gran., bbl., lb	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl, lb	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb	.07½–......	.07½–......	.06½–......
Zinc oxide, lead free, bag., lb	.06½–......	.06½–......	.06½–......
5% lead sulphate, bags, lb	.06½–......	.06½–......	.06½–......
Sulphate, bbl., cwt	2.75 – 3.00	2.75 – 3.00	2.75 – 3.00

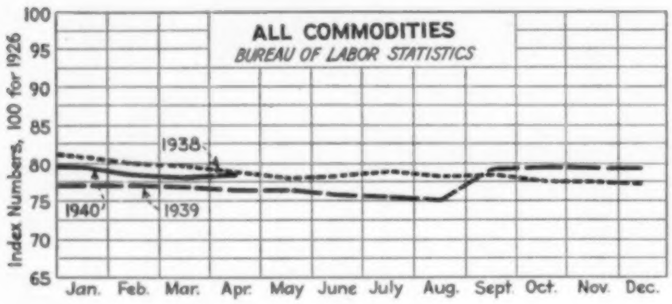
OILS AND FATS

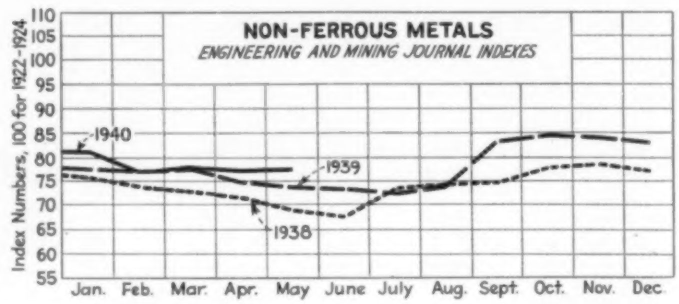
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb	$0.11½–$0.12	$0.11½–$0.12	$0.08½–$0.10
Chinawood oil, bbl., lb	.24 –......	.24 –......	.20 –......
Coconut oil, Ceylon, tank, N. Y., lb	.03 –......	.03½–......	.03½–......
Corn oil crude, tanks (f. o. b. mill), lb	.05½–......	.06½–......	.05½......
Cottonseed oil, crude (f. o. b. mill), tanks, lb	.05½–......	.05½–......	.05½–......
Linseed oil, raw car lots, bbl., lb	.10 –......	.106–......	.088–......
Palm, casks, lb	.04½–......	.04½–......	.03½–......
Peanut oil, crude, tanks (mill), lb	.05½–......	.06½–......	.05½–......
Rapeseed oil, refined, bbl., gal	1.05 –......	1.05 –......	.80 –......
Soya bean, tank, lb	.04½–......	.05½–......	.04½–......
Sulphur (olive foots), bbl., lb	.08½–......	.08½–......	.06½–......
Cod, Newfoundland, bbl., gal	nom.	nom.	.32 –......
Menhaden, light pressed, bbl., lb	.073–......	.073–......	.066–......
Crude, tanks (f. o. b. factory), gal	.33 –......	.33 –......	.28 –......
Grease, yellow, loose, lb	.03½–......	.04½–......	.04½–......
Oleo stearine, lb	.05½–......	.06½–......	.06 –......
Oleo oil, No. 1	.06½–......	.06½–......	.07½–......
Red oil, distilled, d.p. bbl., lb	.08 –......	.08 –......	.07½–......
Tallow, extra, loose, lb	.04½–......	.04½–......	.05½–......

Chem. & Met.'s Weighted Price Indexes









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb	$0.52 -$0.55	$0.52 -$0.55	$0.52 -$0.55
Alpha-naphthylamine, bbl., lb	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb	.15 - .16	.15 - .16	.15 - .16
Aniline, salts, bbl., lb	.22 - .24	.22 - .24	.22 - .24
Benzaldehyde, U.S.P., dr., lb	.85 - .95	.85 - .95	.85 - .95
Benzidine base, bbl., lb	.70 - .75	.70 - .75	.70 - .75
Benzoic acid, U.S.P., kgs., lb	.54 - .56	.54 - .56	.54 - .56
Benzyl chloride, tech., dr., lb	.23 - .25	.23 - .25	.23 - .25
Benzol, 90%, tanks, works, gal	.16 -......	.16 - .18	.16 - .18
Beta-napthol, tech., drums, lb	.23 - .24	.23 - .24	.23 - .24
Cresol, U.S.P., dr., lb	.09½- .10	.09½- .10	.10 - .11
Cresylic acid, dr., wks., gal	.58 - .60	.58 - .60	.69 - .71
Diethylaniline, dr., lb	.40 - .45	.40 - .45	.40 - .45
Dinitrophenol, bbl., lb	.23 - .25	.23 - .25	.23 - .25
Dinitrotoluen, bbl., lb	.15½- .16	.15½- .16	.15 - .16
Dip oil, 15%, dr., gal	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb	.25 - .27	.32 - .36	.32 - .36
H-acid, bbl., lb	.45 - .50	.45 - .55	.50 - .55
Naphthalene, flake, bbl., lb	.07 - .07½	.06½- .07	.05½- .06
Nitrobenzene, dr., lb	.08 - .09	.08 - .09	.08 - .09
Para-nitraniline, bbl., lb	.47 - .49	.47 - .49	.47 - .49
Phenol, U.S.P., drums lb	.13 -......	.13 -......	.14½-......
Picric acid, bbl., lb	.35 - .40	.35 - .40	.35 - .40
Pyridine, dr., gal	1.70 - 1.80	1.70 - 1.80	1.55 - 1.60
Resorcinal, tech., kegs, lb	.75 - .80	.75 - .80	.75 - .80
Salicylic acid, tech., bbl., lb	.33 - .40	.33 - .40	.33 - .40
Solvent naptha, w.w., tanks, gal	.27 -......	.27 -......	.26 -......
Tolidine, bbl., lb	.86 - .88	.86 - .88	.86 - .88
Toluene, drums, works, gal	.30 -......	.30 -......	.27 -......
Xylene, com, tanks, gal	.27 -......	.27 -......	.26 -......

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb	.13 - .14	.11 - .14	[illegible]- .11
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors			
Carbon gas, black (wks.), lb	.028- .30	.028- .30	.02½- .30
Prussian blue, bbl., lb	.36 - .37	.36 - .37	.36 - .37
Ultramarine blue, bbl., lb	.11 - .26	.11 - .26	.10 - .26
Chrome green, bbl., lb	.21½- .30	.028- .30	.21 - .27
Carmine red, tins, lb	4.85 - 5.00	4.85 - 5.00	4.00 - 4.40
Para toner, lb	.75 - .80	.75 - .80	.75 - .80
Vermilion, English, bbl., lb	nom.......	2.46 - 2.50	1.57 - 1.58
Chrome yellow, C.P., bbl., lb	.14½- .15½	.14½- .15½	.14¼- .15½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb	.06 - .06½	.06 - .06½	.06 - .06½
Gum copal Congo, bags, lb	.08 - .30	.08 - .30	.06 - .30
Manila, bags, lb	.09 - .15	.09 - .14	.09 - .14
Damar, Batavia, cases, lb	.10 - .22	.10 - .20	.08 - .24
Kauri, cases, lb	.18 - .60	.18 - .60	.18½- .60
Kieselguhr (f.o.b. N.Y.), ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	50.00 -......	50.00 -......	50.00 -......
Pumice stone, lump, bbl., lb	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb	.03 - .04	.03 - .04	.03 - .04
Rosin, H., bbl	5.50 -......	6.25 -......	6.35 -......
Turpentine, gal	.32 -......	.32 -......	.29¾-......
Shellac, orange, fine, bags, lb	.26 -......	.27 -......	.19 -......
Bleached, bonedry, bags, lb	.25 -......	.25 -......	.18 -......
T. N. Bags, lb	.13½-......	.14½-......	.10 -......
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc. 200 mesh (f.o.b. Vt.), ton	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b. Ga.), ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N.Y.), ton	13.75 -......	13.75 -......	13.75 -......

Industrial Notes

AIR REDUCTION CO., New York, has appointed C. R. Hale purchasing agent to succeed H. M. Dagget retired. Mr. Hale also will act in like capacity for the subsidiary and affiliated companies.

ALLEGHENY LUDLUM STEEL CORP., Pittsburgh, has appointed J. R. Kumer, Jr., to the position of manager of stainless bar and wire sales.

PRATER PULVERIZER CO., Chicago, has placed Brown and Sites Co., 30 Church St., New York, in charge of sales in the New York area.

KESSLER CHEMICAL CORP., Philadelphia, formerly a subsidiary of the American Commercial Alcohol Corp. has been reorganized under the name of Kessler Chemical Co., Inc. Fred E. Loud is president and L. W. Wasum vice-president and technical director.

THE PHOENIX MFG. CO., Joliet, Ill., and Catasauqua, Pa., recently made Lawrence E. Scrannage general manager of its forging division at Catasauqua. Mr. Scrannage is in charge of sales and operations.

FREEPORT SULPHUR CO., New York, has opened an office in Reno, Nev., for the investigation of mineral deposits in the west. A. A. Gustafson is in charge of the exploration work and he will be assisted by Ralph Taylor and David L. Evans.

CHICAGO BRIDGE & IRON CO., Chicago, has made several changes in the personnel of its sales department. H. F. Stearns and A. H. Heineman have been transferred from New York to Birmingham; Herbert A. Guerin from Cleveland to New York; George Jewett from Chicago to New York; S. C. Hamilton from Birmingham to Houston; and Ray Menefee from Chicago to Cleveland.

TECHNICHEMICAL LABORATORIES, New York, has opened new and enlarged laboratories at 24 Stone St. This organization specializes in research in the textile, food, and plastics fields.

NATIONAL OIL PRODUCTS CO., Harrison, N. J., has transferred Truman Fowler former eastern sales representative to the mid-west with headquarters in Chicago. Robert T. Whelan will take over the eastern territory.

WESTERN PRECIPITATION CO., Los Angeles, has opened a sales and engineering office in the Marquette Bldg., Chicago. A. W. Robinson is in charge.

THE G-M LABORATORIES, INC., Chicago, is building a new plant to provide larger manufacturing and research facilities. It is located in the Montrose district on the northwest side.

Chem & Met New CONSTRUCTION

	Current Projects		Cumulative 1940	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$40,000	....	$280,000	$748,000
Middle Atlantic	305,000	$150,000	8,070,000	5,057,000
South	....	2,660,000	11,835,000	16,765,000
Middle West	100,000	185,000	6,825,000	2,765,000
West of Mississippi	3,615,000	540,000	18,990,000	12,561,000
Far West	....	....	4,950,000	4,968,000
Canada	2,585,000	190,000	8,640,000	580,000
Total	$6,645,000	$3,725,000	$59,590,000	$43,444

PROPOSED WORK

Asbestos Development—Rahn Lake Mines Corp., St. Catherines, Ont., Can., plans to develop asbestos property here. Estimated cost $185,000.

Celanese Plant—Canadian Celenase, Ltd., 1501 McGill College Ave., Montreal, Que., Can., contemplates enlarging its plant at Drummondville, Que. Estimated cost $1,250,000. C. E Olive, c/o Owner, Engr.

Cottonseed Oil Mill—Eric Rogers, Jonesboro, Ark., plans to construct a cottonseed oil mill and soy bean crushing plant. Estimated cost $100,000.

Factory—E. I. du Pont de Nemours & Co., Inc., Du Pont Bldg., Wilmington, Del., plans to construct an addition to its factory. Estimated cost will exceed $40,000.

Fertilizer Factory—Fusner Corp., Security Trade Bldg., Indianapolis, Ind., has purchased a site about 3 mi. north of Carey, O., and plans to construct a factory for the manufacture of lawn fertilizer. Estimated cost $100,000.

Mineral Oil Refinery—Royal Manufacturing Co,. 19 North First St., Duquesne, Pa., M. Kovacs in charge, is having preliminary plans prepared for the construction of a refinery at Warren, Pa., to consist of eight buildings. Estimated cost $100,000.

Octane Motor Fuel Plant—Alberta Petroleum Assn., Calgary, Alta., Can., is negotiating for a site at Montreal, Que., and at Toronto, Ont., for the construction of plants for the manufacture of Iso Octane motor fuels for airplanes. Estimated cost $150,000 each.

Gasoline Plant—Texas Natural Gas Co., Borger and Stinnett, Tex., plans to construct and equip a plant for the manufacture of natural gasoline near Borger. Estimated cost $100,000.

Oil Refinery—Atlantic Refining Co., Port Arthur and Corpus Christi, Tex., plans improvements and extensions to its refinery at Port Arthur. Estimated cost $1,500,000.

Oil Refinery—E. C. Johnson, Longview, Tex., contemplates the construction of an oil refinery at Vicksburg, Miss. Estimated cost $320,000.

Oil Refinery—Magnolia Petroleum Co., Beaumont, Tex., plans to modernize and enlarge its refinery units near Port Arthur, Tex.

Oil Refinery—Gulf Refining Co., Gulf Bldg., Houston, Tex., and 17 Battery Pl., New York, N. Y., plans to improve and enlarge its refinery at Port Arthur. Estimated cost $1,000,000.

Oil Refinery—Pure Oil Co., Port Arthur and Corpus Christi, Tex., plans to construct and equip a new thermal polmerization unit at Smith's Bluff near Port Arthur, Tex.

Oil Refinery—Texas Co., c/o D. W. Cresswell, Refining Dept., 135 East 42nd St., New York, N. Y., plans to construct and install a new processing unit at its refinery at Port Arthur, Tex. Estimated cost $250,000.

Paint Factory—Erwin's Paint Works, Mauch Chunk Rd., Bethlehem, Pa., plans to rebuild its 2 1/2 story, 40x100 ft. paint factory recently destroyed by fire. Estimated cost $40,000.

Paper Mill—Building Products, Ltd., 240 St. Patrick St., Montreal, Que., Can., plans to construct a paper mill for the manufacture of asphalt shingles, roofings, insulated sidings, etc., at Winnipeg, Man. Estimated cost $250,000.

Paper Plant—Costania Paper Co., Johnsonburg, Pa.,is having plans prepared by T. K. Hendryx, 165 Interstate Pkway., Bradford, for altering and remodeling its plant. Estimated cost $50,000.

Photographic Paper Plant—Campbell Co., Hicks Ave., Newton, N. J., will soon take bids for the construction of a 1 & 2 story, 65x250 ft. photographic paper sensitising plant. Estimated cost $75,000.

Pulp Mill—W. M. Meighan, c/o Hugh Cunningham, Mayor, Port Moody, B. C., Can., plans to construct a pulp mill at New Westminister, B. C. Estimated cost $300,000.

Phenolic Plastics Plant—Monsanto Chemical Co., 1700 South Second St., St. Louis, Mo., contemplates the construction of a plant at Springfield, Mass., for the manufacture of phenolic plastics.

Recycling Plant—Gulf States Oil Co., c/o P. Kyser, Pres., Edinburg, Tex., plans to construct a recycling plant. Estimated cost $225,000.

Recycling Plant—Hamman Exploration Co., Bay City, and Gulf Bldg., Houston, Tex., plans to construct a recycling plant in the Hammon fields to recycle 20,000,000 ft. gas daily.

Silica Products Plant—Canadian Kaolin Silica Products Ltd., 606 Cathcart St., Montreal, Que., Can., plans to recondition its silica products plant at Lac Remi, Que. Estimated cost $300,000.

CONTRACTS AWARDED

Carbonic Products Factory—Liquid Carbonic Co., 1116 Hemphill St., Houston, Tex., has awarded the contract for the construction of a factory to Kaiser-Ducket Co., 80 East Jackson St., Chicago, Ill. Estimated cost $40,000.

Celanese Plant—Celanese Corp. of America, 180 Madison Ave., New York, N. Y., has awarded contract for addition to plant at Pearisburg, Va., to Virginia Engineering Co., Newport News, Va. Estimated cost $500,000.

Chemical Building—Climax Molybdenum Co., M. W. Murphy, Gen. Mgr., Langeloth, Pa., has awarded the contract for a 1 story, 92x100 ft. addition to its chemical building to Rust Engineering Co., Clark Bldg., Pittsburgh, Pa. Estimated cost $60,000.

Chemical Laboratory—Tennessee, Coal Iron & R. R. Co., Brown Marx Bldg., Birmingham, Ala., has awarded the contract for chemical laboratory and office Building to C. C. Wilborn Construction Co., 2007 Avenue J, Birmingham.

Distillery—Hiram Walker Distillery, Peoria, Ill., has awarded the contract for an experimental distillery to V. Jobst & Sons, Peoria. Estimated cost $65,000.

Factory—Bayer Co., Riverside Ave., Rensselaer, N. Y., has awarded the contract for a 3 story, 75x165 ft. factory to W. G. Sheehan Construction Co., 28-30 DeWitt St., Albany. Estimated cost will exceed $50,000.

Gas Purifying Plant—Union Gas Co. of Canada, Ltd., 48 Fifth St., Chatham, Ont., Can., has awarded the contract for a 1 story, 40x60 ft. gas purifying plant to Robertson Engineering Co., Ltd., Imperial Bank Bldg., Niagara Falls, Ont. Estimated cost $100,000.

Glass Factory—Obear-Nester Glass Co., Bway and Southern Ry. tracks, East St. Louis, Ill. has awarded the contract for an addition to its factory to G. A. Barnes, 4526 Caseyville Ave., East St. Louis. Estimated cost $40,000.

Laboratory—E. I. du Pont de Nemours & Co., 99 Jersey Ave., New Brunswick, N. J., has awarded the contract for a 2 story, 76x116 ft. laboratory to Rogers & Sons, 71 John St., New Brunswick.

Oil Refinery—B. A. Oil Co., Ltd., Canada Cement Bldg., Montreal, Que., Can., has awarded the contract for a new oil separator plant to Scardere & Spino Construction Co., Ltd., 7709 Blvd. St., Lawrence, Montreal. Estimated cost $40,000.

Oil Refinery—Barnsdall Oil Co., Petroleum Bldg., Tulsa, Okla., will enlarge its refineries at Barnsdall, Okla., and Wichita, Kan. Work will be done by company forces. Estimated cost $75,000 and $60,000 respectivey.

Oil Refinery—Wisconsin Oil Refining Co., Sheboygan, Wis., has awarded the contract for a 40x170 ft. topping unit, boiler house, etc., to Butler Manufacturing Co., 900 Sixth Ave., S. E., Minneapolis, Minn.

Paper Mill—Florida Pulp & Paper Co., Pensacola, Fla., will construct a paper mill. Work will be done by separate contracts. Hardy S. Ferguson & Co., 200 Fifth Ave., New York, N. Y., Consult. Engrs. Estimated cost $2,000,000.

Paper Mill—H. Smith Paper Mills, Ltd., 407 McGill St., Montreal, Que., Can., will construct a 1 story, 75x200 ft. addition to its mill. Work will be done by day labor. Estimated cost $50,000.

Paper Plant—Albany Paper Co., Albany, Ga., Kenneth Hodges in charge of construction, will construct a paper plant using its own forces. Estimated cost $40,000.

Refractories Plant—New Castle Refractories Co., Newell, W. Va., has awarded the contract for a 1 story, 35x100 ft. factory to Nellis Construction Co., East Liverpool, O. Estimated cost $40,000.

Thermal Polymerization Plant—Pure Oil Co., c/o R. L. Verner, Beaumont, Tex., has awarded the contract for a plant at Beaumont to Lummus Co., 420 Lexington Ave., New York, N. Y. Estimated cost $325,000.

Tung Oil Mill—E. Wallis, Fornla, Fla., will construct a tung oil expeller mill. Work will be done by owner. Estimated cost including equipment $40,000.

Varnish Factory—Tousey Varnish Co., 520 West 25th St., Chicago, Ill., has awarded the contract for a 2 story, 128x140 ft. factory addition to Stressenrueter Bros., 3020 South Halstead St., Chicago. Estimated cost $40,000.

Wallpaper Factory—Bailey Wallpaper Co., 4001 Pearl Rd., Cleveland, O., has awarded the contract for a 1 story, 50x124 ft. factory to Austin Co., 16112 Euclid Ave., Cleveland. Estimated cost $40,000.